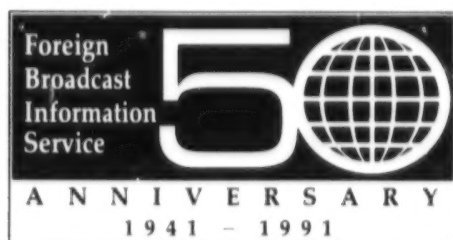


JPRS-CST-91-006
5 MARCH 1991



JPRS Report

Science & Technology

China

Science & Technology China

JPRS-CST-91-006

CONTENTS

5 March 1991

AEROSPACE

Additional Details on Long March 2E Announced [SHIJIE DAODAN YU HANGTIAN, Oct 90]	1
Description of New Launch Pad at Xichang Satellite Launch Center [An Yimin; SHIJIE DAODAN YU HANGTIAN, Oct 90]	1
Efficiency of GaAs Solar Cells Reaches 17 Percent [Zhang Shenfen, Li Xigen; KEJI RIBAO, 10 Jan 91]	3
First Balloon Satellite Successfully Launched [Liu Lusha; GUANGMING RIBAO, 12 Sep 90]	3
Zhi-8 Now in Small-Batch Production [Sang Puquan, Zeng Guibao; JIEFANG RIBAO, 28 Nov 90]	4
Aviation Equipment, Technology Undergo Rapid Progress [Shi Jianping; KEJI RIBAO, 28 Oct 90]	4

ADVANCED MATERIALS

BSO Electro-Optic Crystal Domestically Developed [Jia Baoliang; JIEFANG RIBAO, 1 Oct 90]	6
Large Mercury-Iodide Crystals Grown Domestically [Li Yongtong; SICHUAN RIBAO, 17 Jan 91]	6

BIOTECHNOLOGY

Biotechnology Achievements During Seventh 5-Year Plan [Huang Yong; KEJI RIBAO, 25 Dec 90]	7
Gene Transfer Using Ultrasound [Cheng Meimei, Hu Mucheng; KEJI RIBAO, 19 Dec 90]	7
Gene-Transformed Tobacco Plant [Wang Xu, Xu Zhengzhong; RENMIN RIBAO, 10 Dec 90]	7
Molecular Cloning of Hemolysin Gene From Vibrio Cholerae Strain 18003 [Jiang Min, Li Yuanhao, et al.; ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI, No 6, Dec 90]	7
Characterization and Application of Group-, Serovar- and Strain-Specific Monoclonal Antibodies Against Vibrio Cholerae El Tor Biotype [Yao Chuzheng, Huang Lili, et al.; ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI, No 6, Dec 90]	8
Comparison of Cytotoxicity Between H65-Saporin and H65-Trichosathin [Shen Beifen, Li Yuyun, et al.; ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI, No 6, Dec 90]	8
A Micro Enzyme Plaque Assay of Epidemic Hemorrhagic Fever Virus [Zhu Zhiyong, Tang Hanying, et al.; ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI, No 6, Dec 90]	8
Detection of Specific Antigen Receptors on Peripheral Blood Lymphocytes From HFRS Patients With Monoclonal Anti-Idiotypic Antibodies and Its Clinical Significance [Xu Hui, Liu Junbin, et al.; ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI, No 6, Dec 90]	9
Expression of Human TGF- α / β -Galactosidase Fusion Gene in Insect Cells With a Baculovirus Vector [Li Yiping, Li Mintang, et al.; SHENGWUHUAXUE YU SHENGWUWULI XUEBAO, No 6, Nov 90]	9
The Conformation of Lipid-Vesicle-Bound Cytotoxin MT-B [Zou Zhiyang, Wang Jingying, et al.; SHENGWUHUAXUE YU SHENGWUWULI XUEBAO, No 6, Nov 90]	9
Cloning and Overexpression of the Restriction Gene of EcoRI [Yang Xiangjiao, Chen Changqing, et al.; SHENGWUHUAXUE YU SHENGWUWULI XUEBAO, No 6, Nov 90]	9
Study on Audio-Motor Reaction Under Acute Hypoxia [Zhang Jingxue, Jia Siguang, et al.; ZHONGGUO YINGYONG SHENGLIXUE ZAZHI, No 4, Dec 90]	10

COMPUTERS

TRANSCUBE: Hypercube Multiprocessor System [Xu Chengzhong; XIAOXING WEIXING JISUANJI XITONG, Jan 91]	11
Anti-Virus Hard-Disk Protection Device Developed [Zhou Axin; KEJI RIBAO, 12 Jan 91]	11
Special Report on Information Technology/Optoelectronics in 863 Plan	12
Overview [Xu Xiaodi; KEJI RIBAO, 16 Sep 90]	12
Information Acquisition, Processing Technology [Kuang Dingbo; KEJI RIBAO, 16 Sep 90]	13
Intelligent Computer Technology [Wang Chengwei; KEJI RIBAO, 16 Sep 90]	13
Optoelectronics Technology [Zhou Bingkun; KEJI RIBAO, 16 Sep 90]	14
Optoelectronics Research [KEJI RIBAO, 16 Sep 90]	15
Roster of Expert Group Members [KEJI RIBAO, 16 Sep 90]	15
Photograph Captions [KEJI RIBAO, 16 Sep 90]	16
First Domestic IC CAM System Developed [Hua Shi, Chen Shuxin; ZHONGGUO DIANZI BAO, 30 Dec 90]	16
Multi-Font, Multi-Symbol Chinese-Character Recognition System, High-Speed Reader Developed [Hai Ping; JISUANJI SHIJIE, 16 Jan 91]	17
Further Advances in Printed-Chinese-Character Recognition Technology [Han Yun; JISUANJI SHIJIE, 16 Jan 91]	17
Military Fuzzy-Logic-Based Pattern Recognition System Developed [Chang Gong; JISUANJI SHIJIE, 16 Jan 91]	18
First Domestic Transplant of UNIX System V [Du Cai; JISUANJI SHIJIE, 23 Jan 91]	18

FACTORY AUTOMATION, ROBOTICS

Developments in CNC Machine Tools, FMS Technology Reported	19
Second National FMS Conference Held in Dalian [Xu Jiamo; ZUHE JICHUANG YU ZIDONGHUA JISHU, Oct 90]	19
Domestic NC Machine Tool CAD Software [Chang Ming; JICHUANG, Oct 90]	20
Domestic Ultraprecision Machining Technology [Chang Ming; JICHUANG, Oct 90]	20
BS-7501 High-Performance CNC System Accredited [Wang Xiren; JISUANJI SHIJIE, 17 Oct 90]	20

LASERS, SENSORS, OPTICS

Two New Optical Devices Accredited [HUAZHONG LIGONG DAXUE XUEBAO, Dec 90]	22
1.3-Micron Single-Mode Laser Light Source Developed [Wei Baozhi; ZHONGGUO DIANZI BAO, 11 Jan 91]	22
Accuracy of Weak-Magnetic-Field Induction-Density Measurement at State-of-the Art [Ji Liang; KEJI RIBAO, 11 Jan 91]	22
Tungsten-Disk Ar-Ion Laser, Laser Focusing Device Accredited [Chen Zhihao, Feng Ping; ZHONGGUO DIANZI BAO, 13 Jan 91]	22
New Advances in Optical Thin-Film Research at Institute 11 [Li Qiongrui; ZHONGGUO DIANZI BAO, 13 Jan 91]	22
Domestic Advances in Integrated Optics [Peng Jihu; ZHONGGUO DIANZI BAO, 18 Jan 91]	23
Domestic Development of Fiber-Optic Sensors [Liao Yanbiao; ZHONGGUO DIANZI BAO, 20 Jan 91]	23
Optical Thin Films Resistant to High-Power Laser Damage Developed [Li Qiongrui, Hong Zhang; ZHONGGUO DIANZI BAO, 25 Jan 91]	23
First Application of Fiber-Optic Sensors to High-Voltage Measurement [Ren Guangquan; ZHONGGUO DIANZI BAO, 25 Jan 91]	24

MICROELECTRONICS

New-Generation HEMT Developed [Zheng Zhaosen; ZHONGGUO DIANZI BAO, 11 Jan 91]	25
Series of 16-Bit Microcomputer Processors Accredited [Jie Yannan; ZHONGGUO DIANZI BAO, 9 Jan 91]	25
Breakthrough in RISC Chip-Fabrication Technology [Xiao Qiang; ZHONGGUO DIANZI BAO, 27 Jan 91]	25
New ICs Developed by Qinghua University Microelectronics Institute [Shi Jianping; KEJI RIBAO, 23 Jan 91]	25

13 Types of ASICs Pass Appraisal [Liu Keli; JISUANJI SHIJIE, 16 Jan 91]	25
GaAs VHSICs, Other ICs Developed by Institute 13 [Shi Xuan; ZHONGGUO DIANZI BAO, 16 Jan 91]	26
10 New ASICs Pass Appraisal [Liu Keli, Lian Jiangzhou; ZHONGGUO DIANZI BAO, 11 Jan 91]	26
Study of Recombination Centre Levels In N-Type LPE GaAs Layers Irradiated by Electrons [Hu Yusheng, Wang Le, et al; BANDAOTI XUEBAO, Dec 90]	26
Calculation of EL2 Energy Level and Optical Cross Section of Semi-Insulating GaAs Crystal [Wang Chuankui, Xu Wantang; BANDAOTI XUEBAO, Dec 90]	26
Low-Dark-Current High-Gain InGaAs/Inp SAGM APD [Wang Shutang, Zeng Jing, et al; BANDAOTI XUEBAO, Dec 90]	26

SUPERCONDUCTIVITY

World Record Claimed for YBCO Thin-Film Critical Current Density [KEJI RIBAO, 9 Jan 91]	28
---	----

TELECOMMUNICATIONS R&D

More Developments in Fiber-Optic Communications Described	29
First Domestic Fiber-Optic LAN Using Chinese Components [Gao Yuqian; JISUANJI SHIJIE, 26 Dec 90]	29
Shanghai Becoming Major Production Center [Jia Baoliang; JIEFANG RIBAO, 1 Jan 91]	29
Unrepeated Undersea System Operational [Li Yupei; ZHONGGUO DIANZI BAO, 2 Jan 91]	29
14 Achievements Accredited [Li Guoyi; ZHONGGUO DIANZI BAO, 4 Jan 91]	29
Focus on Shanghai Engineering Company [Yue Ziqiang; KEJI RIBAO, 5 Jan 91]	30
24-Fiber Optical Cable Developed [Wang Kejian; KEJI RIBAO, 5 Jan 91]	30
National Statistics Released [DIANXIN JISHU, Jan 91]	30
Fiber-Optic Line for Xinjiang Province [DIANXIN JISHU, Jan 91]	30
Local Relay Line for Shantou City [Yang Miaosheng, Xu Weiguang; DIANXIN JISHU, Jan 91]	31
New Domestically Made Optoelectronic Terminals [DIANXIN JISHU, Jan 91]	31

PHYSICS

Shape Measurement of Synchrotron Radiation With High Time Resolution [Cao Zhong, Liu Weiren, et al.; GAONENG WULI YU HE WULI, No 8, Aug 90]	32
--	----

Additional Details on Long March 2E Announced

91P60093A Beijing SHIJIE DAODAN YU HANGTIAN [MISSILES & SPACECRAFT] in Chinese No 10, Oct 90 pp 1-3, 5

[Unsigned article: "Successful Test Launch of Long March 2E"]

[Summary] On 16 July 1990, the first test flight of a Long March 2E (CZ 2E) launch vehicle (LV) was successfully conducted from the Xichang Satellite Launch Center (XSLC). The new LV, which carried into orbit a dummy Aussat-B satellite piggybacked with Pakistan's Badr-A experimental satellite, will be employed to launch Aussat-B1 and -B2 communications satellites in 1991 and 1992. By using the LH₂/LOX upper stage currently under development in the CZ 3A program on the LV, a new LV capable of putting a 4.5-ton payload into geosynchronous transfer orbit (GTO) can be formed.

The CZ 2E is a 50-m-long, 3.35-m-core-diameter two-stage heavy LV developed from the CZ 2C with the addition of four 2.25-m-diameter, 15.4-m-long liquid-fuel strap-on boosters. The first and second stages of its core are 4.6 m longer and 5.2 m longer, respectively, than those of the CZ 2C. Maximum diameter of the payload fairing is 4.2 m and length is 10.5 m; gross liftoff weight of the entire LV is 461 tons.

The development of the CZ 2E, conceptually initiated in 1986, is marked by the June 1988 signing of a contract between CGWIC and Hughes Aircraft for the former to launch two [recovered] Hughes-built satellites as Aussats; the program was ratified by the State Council on 14 December 1988, initiating full-scale development. The main contractor was the Chinese Academy of Launch-Vehicle Technology (CALT) (Beijing Wanyuan [8001 3293] Industrial Co.).

The CZ 2E's first stage has four engines, each capable of generating a thrust of 744 kilonewtons (kN), compared to a thrust of 686kN for each CZ 2C engine. Each strap-on booster has this same [744kN] engine. The second stage utilizes five main engines with added high-altitude nozzles, each engine having a vacuum thrust of 736kN; also, there are four floating engines which surround the main engines and which provide a total thrust of 47kN. To realize thrust vector control, the first stage's four engines and the second stage's floating engine nozzles are all rotary [i.e., gimbal-mounted]. All engines utilize UDMH/N₂O₂ propellant.

At liftoff, the eight engines of the core first stage/strap-on booster combination generate a takeoff thrust of 5952kN. Strap-on-booster-engine operating time is 125 seconds, and each strap-on booster has mounted on it four outboard side-thrust solid rockets, which operate after cutoff of the strap-on booster engines. Core first-stage cutoff is at 158 seconds after liftoff, at which point occurs second-stage ignition and separation from the first stage. An improvement in the second stage is the addition of a propellant utilization system, which has

increased the LV's low-Earth-orbit (LEO) carrying capacity by 700 kg. The second stage's main engines and four floating engines operate for 301 seconds and 414 seconds, respectively; after this, the attitude-adjustment system begins operation. The propellant utilization system employs the switched nozzle method, with nozzles mounted on the second-stage frame, to control payload orientation in terms of pitch, roll, and yaw. After orientation is completed, 3-kN-thrust start-spin [qi xuan] rocket(s) ignite and operate for 0.5 second; 0.2 second later, satellite-LV separation occurs and the payload enters the preassigned orbit.

Compared to that of the CZ 2C, the CZ 2E's carrying capacity is significantly higher: the latter can put an 8800kg payload into a 200-km-high 28.5°-inclination LEO (compared to the 2500-kg LEO carrying capacity of the CZ 2C). The LV uses the unpolluted, soft fairing separation method; the fairing has a clamshell-type structure, and uses primacord for longitudinal unlocking and an unpolluted explosive-bolt/separation-spring method for transverse unlocking. The fairing permits a payload clearance diameter of no less than 3.7-3.8 m.

The CZ 2E's guidance system uses an improved version of the CZ 2C's platform-computer technique. The CZ 2E's attitude control system utilizes a digital control method.

The first-phase goal for use of the CZ 2E is that it be competitive as a vehicle for launching the kinds of commercial communications satellites originally scheduled to be launched by the U.S.'s space shuttle. For this reason, the CZ 2E is designed to take an upper stage generally matching any of several foreign-made upper stages (such as the PAM-D3, PAM-D4, AMS, SCOTS, STV, etc.) for placing satellites into GTO.

Description of New Launch Pad at Xichang Satellite Launch Center

91P60093B Beijing SHIJIE DAODAN YU HANGTIAN [MISSILES & SPACECRAFT] in Chinese No 10, Oct 90 pp 13-15

[Article by An Yimin [1344 3015 3046] of the Beijing Institute of Special Engineering Design: "Introduction of New Launch-Pad Construction at Xichang"]

[Summary] China's first launch of the Long March 2E (CZ 2E) launch vehicle (LV) in July used a newly constructed launch complex located in the Xichang Satellite Launch Center (XSLC). The complex, which is composed of a 97-m-high mobile tower and a 74-m-high fixed tower, is the largest one in the nation. In addition to the CZ 2E, it can also be used to launch even larger Long March boosters to be developed in the future. Technical facilities and equipment of the new complex are introduced here.

The overall design of the new complex—as well as the design of various special-project equipment—was undertaken by the Beijing Institute of Special Engineering

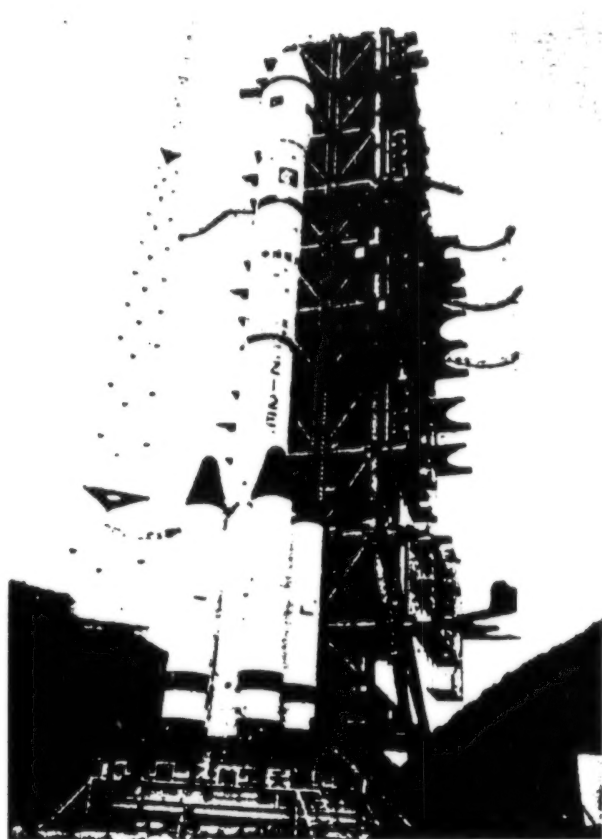


Figure 1. Long March 2E on Launch Pad at XSLC

Design, which also oversaw plant machining and manufacturing, on-site construction and equipment installation, debugging, and trial operation. Construction of the towers, from engineering drawings to the point where the new facility was made available for use, took only 18 months—a remarkable feat accomplished by the cooperation of many parties, considering that other nations usually take 3-4 years to build a launch complex of such scale.

The new launch site, located at the south side of the original facility, is 300 meters from the old site, and the new pad is in the eastern part of the new site, while the launch control center (room)—a reinforced concrete structure—is in the western portion of the new site. Construction of the propellant filling and discharge system and other systems (see enumeration below), based on facilities at the original site but with improvements, has been completed. The principal technical equipment and installations include the following: a π -type mobile operating tower, a fixed umbilical cord tower, a launch pad, a guide trough with tracks, the launch control center, the LV/satellite electrical supply and distribution mains area, the cable connection area, the conventional-propellant filling and discharge system, the cryogenic-propellant filling and discharge system, the nitrogen/helium/air supply and distribution system, the communications and TV monitoring system, the high-speed photographic measurement equipment, the electrical supply and distribution system, the water-supply/sewage/water-purification system, the fire-alarm

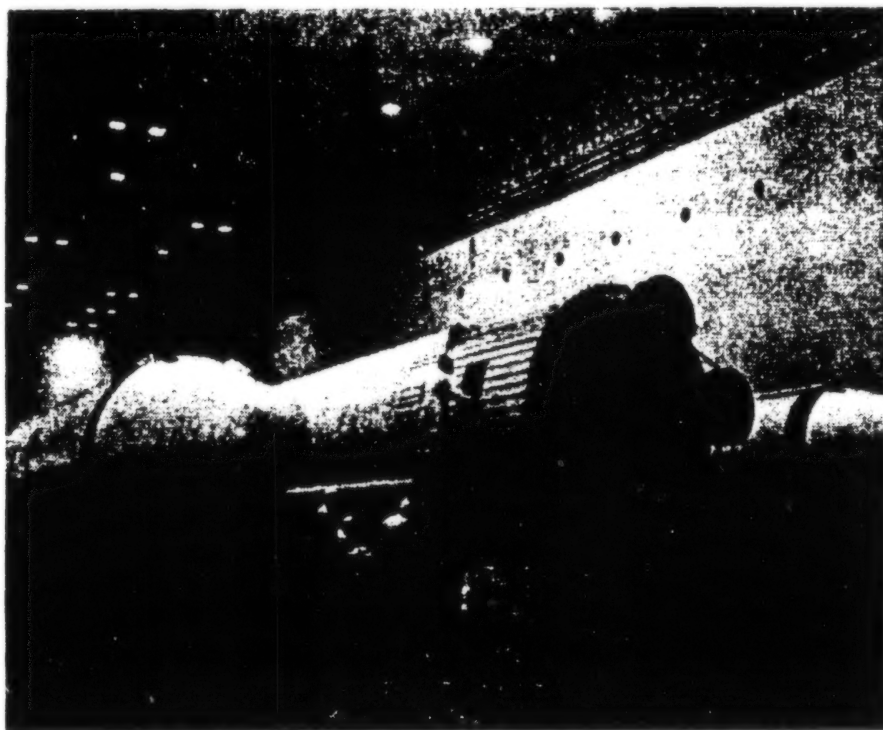


Figure 2. Long March 2E Undergoing Indoor Technical Checkout; Shown With Two Liquid-Fuel Strap-On Boosters

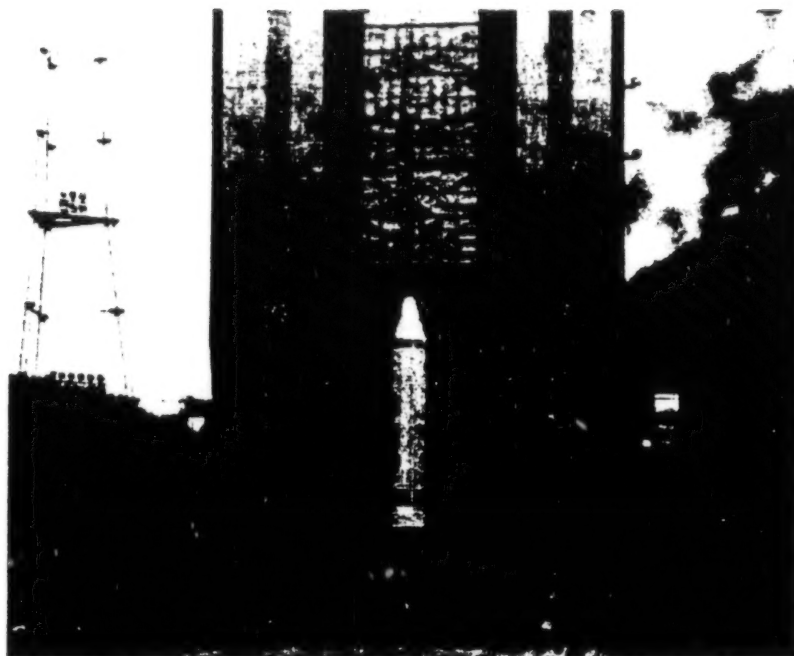


Figure 3. Long March 2E Strap-On Booster-Being Hoisted

system, the air-conditioning equipment, the launch-area anti-lightning grounding equipment, roads, bridges, etc.

The 97.6-m-high π -type mobile tower weighs 4580 tons and moves with 64 wheels on four steel tracks over a range of 130 m. The gantry crane's main hook can handle 20 tons, while the secondary hook can lift 10 tons; maximum lifting height for both hooks is 84 m. The operating platform has 17 stories, and the explosion-proof elevator can lift 1500 kg.

The 74-m-high fixed tower weighs 1025 tons, has 11 stories with fixed platform floors, 4 inter-story floors, 7 inter-story platforms, and 28 operating areas. Installed on the fixed tower are a 5-story revolving platform, an 8-level work platform, a 2-level revolving overline bridge and one 1000-kg-capacity elevator.

The electrical distribution system for the entire new complex provides 380/220V, 50Hz and 208/120V, 60Hz power supplies.

Efficiency of GaAs Solar Cells Reaches 17 Percent

91P60109 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 10 Jan 91 p 1

[Article by Zhang Shenfen [1728 3947 5358] and Li Xigen [2621 0823 2704]: "Shanghai Develops High-Efficiency Satellite Power Supply"]

[Summary] The technological level of domestically made gallium arsenide (GaAs) solar cells used for satellite

power supplies has reached the mid-eighties international standard with the announcement that the maximum efficiency of the GaAs solar cells used to provide power for the FY-1B meteorological satellite for over 3 months has broken through the 17 percent mark. These high-efficiency GaAs solar cells, jointly developed over a 5-year period by MAAI's Shanghai Xinyu Power Supply Plant and the CAS Shanghai Institute of Metallurgy, will also be used aboard the FY-2, the next-generation metsat currently being developed. With this breakthrough, China becomes the fourth nation in the world (after the U.S., USSR, and Japan) to successfully develop and apply this technology.

First Balloon Satellite Successfully Launched

91FE0141A Beijing GUANGMING RIBAO in Chinese 12 Sep 90 p 1

[Article by reporter Liu Lusha [0491 6424 3097]]

[Text] Today the Chinese Academy of Sciences (CAS) Space Science and Applied Research Center announced that two balloon satellites, "Daqi-1", launched along with the second "Fengyun-1" experimental weather satellite have been in orbit for 9 days. The Beijing, Nanjing, Changchun, Kunming, Xi'an, Guangzhou, and Urumqi satellite observation stations have all locked onto their targets, and in the process of observing and tracking them, have gathered valuable scientific data. These are China's first upper atmosphere balloon satellites.

"Daqi-1" balloon A is about 3 meters in diameter, and balloon B is about 2 meters in diameter. They are made of 50-micron aluminum-coated polyester. On 3 September they were carried along with the second "Fengyun-1" experimental weather satellite on the

"Long March-4" launch vehicle. At the time of the launch they were packed in a 40 centimeter container, and after the rocket reached its prescribed orbit, they were released by an ejector mechanism. The residual gasses and sublimate inside the balloons produced a pressure that rapidly inflated the satellites into spheres, while their inertia kept them moving in orbit at a high rate of speed. Because the volume of each balloon is large, and their mass is light, they create friction in the rarified atmosphere, and as changes in their orbits are detected by ground observers, the atmospheric density along their paths can be calculated.

"Daqi-1" will make possible, for the first time, the collection of data on atmospheric density in an altitude range of 400 to 900 kilometers. It will be a valuable tool for research on the upper atmosphere, and for designing and predicting space vehicle orbits. "Daqi-1" is an important event in China's high-tech planning. It is the product of a joint effort by the Chinese Academy of Sciences' Space Science and Applied Research Center, relevant elements of the Ministry of Aeronautics and Astronautics, CAS Purple Mountain Observatory, the applied research center of the man-made satellite system, and Beijing University.

Zhi-8 Now in Small-Batch Production

91FE0209A Shanghai JIEFANG RIBAO in Chinese
28 Nov 90 p 5

[Article by reporter Sang Puquan [2718 2528 3123], and special correspondent Zeng Guibao [2582 2510 0202]]

[Text] *This is a special report from Jingdezhen.* The Chinese-made large helicopter called the "Zhi-8" has been put into small-batch production at the Changhe Aircraft Factory. The "Zhi-8" is the "strong man" on the list of Chinese produced helicopters. Its maximum flying weight is 13 metric tons, and it is capable of 800 kilometers of continuous flight on one tank of fuel, more than enough to fly from the Xisha Archipelago to the Nansha Archipelago.

On the assembly line of the No 36 Shop of the Changhe Aircraft Factory, reporters saw a newly assembled green helicopter in its embryonic form, and a group of young assembly workers installing a web of electrical wiring. In January of next year this "Zhi-8" will be put into use. The reporters stepped onto the metal gangway, but could see only that the bay was quite spacious, about the size of two truck beds. According to the brief, it can carry two jeeps, or seat 27 fully armed combat troops. With additional seats it could accommodate a reinforced platoon. Unlike other helicopters, the underside of the "Zhi-8" is shaped like a boat, and it has landing gear on either side with which it can take off, land, and float on water.

According to the estimates of specialists, China's helicopter industry got started more than 10 years after the other aircraft industries, and was well behind in technology. The largest helicopter produced by China in the

fifties and sixties was the "Zhi-5", which had a maximum flying weight of only 7 tons, and actually was like the Soviet Mi-4 small helicopter. China's territory is vast, and deployment of large helicopters is needed for national defense construction and the economy and there is no better way to fulfill that need than to design and manufacture them independently. The Changhe Aircraft Factory, and the China Helicopter Design and Research Institute took up the challenge under great hardships, and after 15 years of struggle, sent the "Zhi-8" aloft on 11 December 1985. After flying on its own, it went on through the test flight and acceptance program, passed national level technology appraisal and acceptance, and was put into production this year. In talking about this exceptional year, the Chief of the Changhe Aircraft Factory, Li Wanxin [2621 5502 2450] said, 'the "Zhi-8" is our heart and soul'. Especially since 1980, the year of national economic readjustment, national investments were cut back, and the "Zhi-8" project was reclassified from priority to postponed. The people of Changhe, sticking with the development of this people's product, invested funds, and pledged that work on the "Zhi-8" would not be interrupted, but would get off the ground and into the skies.

As a national first class product, the "Zhi-8" uses many new materials in its more than 20,000 parts. Its new technology, and new techniques, and the accumulated services of over 300 domestic factories has made this new machine the ultimate grassroots achievement of the national production program. Not long ago, nationally produced engines also enjoyed a huge success, and the next "Zhi-8" may be installed with a nationally produced "heart". It has been revealed that the Changhe Aircraft Factory, and the China Helicopter Design and Research Institute are holding discussions on, and planning the establishment of a Chinese Helicopter S&T and production base at Jingdezhen.

Internationally, helicopters over a 10-ton flying weight are classified as large helicopters. Now, only the Soviet Union, U.S., U.K., and France can produce such helicopters. After China's "Zhi-8" gets into production, several developing countries have expressed an interest in buying it. The day the "Zhi-8" will be flying abroad is not a long way away.

Aviation Equipment, Technology Undergo Rapid Progress

91FE0141B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 28 Oct 90 p 1

[Article by reporter Shi Jianping 4258 1696 1627]]

[Text] Through 40 years of effort, China's aircraft engine, aircraft equipment, and aircraft S&T have developed in scale and capability, basically fulfilling domestic requirements for design and manufacture of aircraft to the point where, in the 10 years since the reforms began, the aircraft industry has opened the gateway to the world, and further increased its pace of development.

The aircraft engine industry developed from one that was mainly limited to repairing and copying engines to an industry of quite broad scale; a high-tech industry capable of independent design, composed of high level enterprises and S&T organizations outfitted with advanced production, testing facilities, and procedures that have produced more than 50 models of engines.

National requirements for aircraft equipment for the various kinds of aircraft have been fulfilled. Substantial achievements have been made in the fabrication of comprehensive avionics systems, comprehensive head-up display systems, inertial guidance systems, flight control systems, on-board radar, high pressure dehumidifiers, and pressurized environmental control equipment, pilot ejection seats, and components. Many have been tested in flight, and some have been finalized and put into use.

The Ministry of Aeronautics and Astronautics S&T Academy has developed broad-ranging relationships with foreign S&T organizations and major colleges, and has engaged in over 100 cooperative projects.

As a means to reduce the gap between China's aircraft industry and advanced world levels, and promote international cooperation, the Ministry of Aeronautics and Astronautics Avionics General Corporation, Aerospace Research Academy, Aero-engine General Corporation, and the Beijing Committee of the China International Trade Promotion Commission have jointly arranged the 1990 China International Aviation Equipment and Technology Fair. The fair will provide an excellent place for technical exchange, holding trade talks, and promoting international cooperation.

BSO Electro-Optic Crystal Domestically Developed

91P60105 Shanghai JIEFANG RIBAO in Chinese
1 Oct 90 p 2

[Article by Jia Baoliang [6328 1405 5328]: "BSO Electro-Optic Crystal Debuts in Shanghai"]

[Summary] BSO electro-optic crystal, developed over a 3-year period for the first time domestically by the CAS Shanghai Institute of Silicate Chemistry & Engineering, passed the relevant national-level expert appraisal in Shanghai the other day. In addition, this new type of crystal has been successfully incorporated by Chinese scientists into an optical-information real-time recording and processing system, indicating that domestic research in this area is at the world's forefront.

BSO electro-optic crystal, which has applications in optical information processing, optical computing, and nondestructive laser detection, as well as in advanced aerospace technology, has heretofore been developed by only a small number of nations, including the U.S., the USSR, and Japan. The experts at the technical appraisal noted that the material's performance matches the advanced standards of the comparable American-made material, and moreover that certain technical indicators exceed current international standards.

Large Mercury-Iodide Crystals Grown Domestically

91P60108 Chengdu SICHUAN RIBAO in Chinese
17 Jan 91 p 1

[Article by Li Yongtong [2621 3057 1749]: "Large Mercury-Iodide Monocrystals Successfully Grown Domestically"]

[Summary] Researchers at Sichuan University's Materials Science Department for the first time internationally have been able to grow large mercury-iodide (HgI_2) monocrystals via a vapor-phase fixed-point method along with the associated monocrystal growth apparatus. The Sichuan University scientists, who began their research project in 1984, have successfully grown HgI_2 monocrystals over 200 grams in weight with a yield of 100 percent. The researchers were supported by grants from the Natural Science Foundation of China and from the State 863 Program. Applications of this monocrystal, which formally passed the appraisal sponsored by the State Education Commission on 12 January 1991, include national defense, nuclear medicine, mineral prospecting, electron microscopy, non-destructive testing, astronomy, and high-energy physics.

Biotechnology Achievements During Seventh 5-Year Plan

91P60103a Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 25 Dec 90 p 1

[Article by Huang Yong [7806 0516]: "Seventh 5-Year Plan Biological Key Research Projects Attain Significant Results"]

[Summary] Zhou Guangzhao, director of the Chinese Academy of Sciences, announced on 24 December that the first Chinese-made gene-engineered pharmaceutical drug, the hepatitis B vaccine, will soon complete intermediate testing and be put into production. The success is the most significant achievement of Chinese scientists during the Seventh 5-Year Plan in biotechnology research. Among the key research results attained during the Seventh 5-Year Plan, 113, including hepatitis B vaccine, were put into production. Biotechnology has been listed as one of the nation's key S&T tasks during the Seventh 5-Year Plan, and eight key subjects, including the development of gene-engineered products, were chosen.

In the area of gene-engineered pharmaceutical drugs and vaccines, intermediate testing, clinical trials and field tests of seven products such as hepatitis B, α -1 interferon and vaccine against diarrhea in young livestock will soon be completed.

In the area of plant gene engineering, production of a series of viral disease-resistant, pesticide and herbicide-resistant gene-engineered plants was achieved, and two of these gene-engineered plants have already undergone field tests. The successes in obtaining gene-transformed rabbits capable of expressing hepatitis B surface antigen, and the attainment of regenerated plants from protoplasts of rice, wheat, corn, sorghum, and soybean, have taken China into the ranks of the world's advanced nations. In the area of cell-engineered breeding, nine approved new varieties have been obtained, eleven of which have passed field tests and are already used as production varieties of crops. The wide applications of these three varieties, "Jinghua No. 3" wheat, "Xiaoyan No. 107" wheat, and "Zhonghua No. 10" rice, have increased grain yield by 85 million kilograms.

In the area of microbial biotechnology, successes in new technology development and new product research in the process of developing penicillin acylase have gained acknowledgement throughout the country. Although China has just started in the area of biomedical engineering, it has succeeded in batch-producing 2.5-liter, 5-liter and 10-liter automatically controlled fermenters. The Chinese-made 100-cubic-meter, double-circulation, gas-lift reactor has raised the glutamic acid production rate by 13.6 percent. China will surely make more than 100 million yuan in profit from using this kind of reactor throughout the MSG plants in the country. The use of sterilization-resistant PH sensors in penicillin-producing processes has raised the rate of producing penicillin by 7,000 units per milliliter, which will bring a 7 million

yuan economic gain to China. Zhou Guangzhao pointed out that these breakthroughs are the milestones of Chinese biotechnology development.

Gene Transfer Using Ultrasound

91P60103c Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Dec 90 p 1

[Article by Cheng Meimei [4453 4168 4168], Hu Mucheng [5170 2606 2052]: "China Accomplishes Plant Gene Transformation Using Ultrasonic Wave"]

[Summary] Researchers at the Biological Sciences and Technology Department of Qinghua University and the Biotechnology Research Center of the Academy of Agricultural Sciences have succeeded in transferring plant genes using ultrasonic waves. The cavitation mechanism of ultrasound made possible the insertion of foreign genes into wheat spikelet calli, from which a temporary high-frequency expression was attained, and the obtaining of a regenerated gene-transformed new tobacco plant with permanent, stable expression by inserting foreign genes into the tobacco leaf nub. The researchers believe that this highly effective ultrasonic technique of inserting foreign genes can be widely applied in the majority of plants. This easy ultrasonic technique will be a better method for breeding superior plant varieties than the more popular gene-gun laser method.

Gene-Transformed Tobacco Plant

91P60103b Beijing RENMIN RIBAO in Chinese 10 Dec 90 p 3

[Article by Wang Xu [3769 2485], Xu Zhengzhong [6079 2973 0022]: "Success in Producing First Gene-Transformed Pesticidal Tobacco Plant"]

[Summary] The research result of the Seventh 5-Year key project carried out by the Microbiology Institute of the Chinese Academy of Sciences passed appraisal recently. Through agrobacterial vectors the researchers were able to transfer the crystalized protein of highly effective pesticidal gene from *Bacillus thuringiensis* to tobacco plants, thus producing a gene-transformed tobacco plant with 90-100 percent effectiveness in killing pests infecting these plants. The achievement indicates that Chinese biotechnology now ranks among the world's most advanced.

Molecular Cloning of Hemolysin Gene From *Vibrio Cholerae* Strain 18003

40091006A Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 6, Dec 90 pp 349-352

[English abstract of article by Jiang Min [1203 2404], Li Yuanhao [2621 0337 3185], et al., of the National Institute for Control of Pharmaceutical and Biological Products]

[Text] El Tor *Vibrio cholerae* strain 18003 isolated in this country is strongly hemolytic on blood agar plate. We successfully cloned the DNA fragment encoding the hemolysin of this bacterium into the plasmid vector pBR322. The resultant plasmid, pJL412 has a 5.9kb Pst I DNA insert which leads to the production of the hemolysin in *E. coli* HB101. A subcloned 3.4kb DNA fragment from pJL412 was found to be necessary for hemolytic activity. By using southern hybridization, we have proved that the cloned hemolysin gene has homologous DNA fragment of the hemolysin gene which Poul A. Manning has reported.

Characterization and Application of Group-, Serovar- and Strain-Specific Monoclonal Antibodies Against *Vibrio Cholerae* El Tor Biotype

40091006B Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 6, Dec 90 pp 353-356

[English abstract of article by Yao Chuzheng [1202 2806 6927], Huang Lili [7806 5461 5461], et al., of the Institute of Epidemiology and Microbiology, Chinese Academy of Preventive Medicine, Beijing]

[Text] Using hybridoma technique, we obtained a panel of monoclonal antibodies (McAbs) against *Vibrio cholerae* El Tor biotype. Reactivities of these McAbs were investigated with ELISA technique. According to their reactivities these McAbs could be divided into four classes. The first class reacted to both Inaba and Ogawa serovars (A antigen). The second class reacted to the Ogawa serovars only (B antigen), while the third class reacted only to the Inaba serovars (C antigen). And the fourth class showed reactivity to epidemic strains of both Ogawa and Inaba serovars, so the McAbs in this class are able to distinguish the epidemic from the non-epidemic strains of *Vibrio cholerae* El Tor biotype. Application of these McAbs for identification and rapid diagnosis of *Vibrio cholerae* El Tor biotype was discussed.

Comparison of Cytotoxicity Between H65-Saporin and H65-Trichosathin

40091006C Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 6, Dec 90 pp 361-365

[English abstract of article by Shen Beifen [3088 0223 1164], Li Yuyun [2621 6877 0061], et al., of the Institute of Basic Medical Sciences, Academy of Military Medical Sciences, Beijing]

[Text] Saporin is a kind of single chain ribosome inactivating protein, with similar functions of A chain of holotoxins. The immunotoxins (IT) containing hemitoxins exhibited potent cytotoxic activity against target

cells without dependence on B chain. Unfortunately, saporin showed evident hepatotoxicity in vivo. Trichosathin is another single chain ribosome inactivating protein, its structure is very similar to ricin A chain. In a rabbit reticulocyte lysate cell-free system, IC₅₀ (inhibiting concentration 50 percent) of saporin and trichosathin was 1.4×10^{-8} mol/L and 1.5×10^{-8} mol/L respectively. At the same concentration there was no cytotoxic effect on the intact cells. After crosslinking the hemitoxins to H65 monoclonal antibody (CD₅), the immunotoxins showed the potent cytotoxic activity to target cells-Molt 4, but not to nontarget cells-SB. The IC₅₀ of H65-saporin and H65-trichosathin was 10^{-12} and 10^{-11} mol/L respectively. The IT killing log was estimated by clonogenic assay. At 10^{-7} mol/L H65-saporin and H65-trichosathin were able to induce 4-3 log reduction of clonogenic Molt-4 cell growth. Although H65-trichosathin had less cytotoxic effect than that of H65-saporin, it showed less toxicity to hematopoietic progenitor cells. At 10^{-7} mol/L, 80 percent of CFU-GM was inhibited by H65-saporin, while only 20 percent by H65-trichosathin.

As for preparation of IT ricin A chain may be replaced by trichosathin.

A Micro Enzyme Plaque Assay of Epidemic Hemorrhagic Fever Virus

40091006D Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 6, Dec 90 pp 391-395

[English abstract of article by Zhu Zhiyong [2612 2535 0516], Tang Hanying [0781 3352 5391], et al., of the Zhejiang Provincial Health and Anti-Epidemic Station, Hangzhou]

[Text] After a serial test of various experimental conditions, a micro enzyme plaque assay of direct staining the EHF virus infected cells with EHF-IgG-HPR and the substrate has been developed. Monolayer of Vero-E₆ cells overlaid with growth medium containing 1 percent carboxymethyl cellulose was infected with EHF virus, and incubated for 4 days. Then a simple test proceeding within 1 hour including fixation with 100 percent alcohol and staining with EHF-IgG-HPR and substrate (odiarisidine) was performed. The enzyme plaque could be enumerated under microscope. Five EHF virus strains could form similar enzyme plaque containing dozens of infected cells. In micro enzyme plaque assay, a linear relationship between the number of enzyme plaques and virus concentration was observed. The virus titre measured by the enzyme assay was similar to that measured by immunofluorescent TCID₅₀ method but they were both lower than animal (*M. unguiculatus*) test. The enzyme plaque reduction neutralization test has been shown to be able to detect the titre of neutralizing antibody against EHF virus.

Detection of Specific Antigen Receptors on Peripheral Blood Lymphocytes From HFRS Patients With Monoclonal Anti-Idiotypic Antibodies and Its Clinical Significance

40091006E Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 6, Dec 90 pp 396-399

[English abstract of article by Xu Hui [6079 6540], Liu Junbin [0491 0193 1755], et al., of the Department of Microbiology, the Fourth Military Medical University, Xian]

[Text] An indirect immunofluorescent assay was established for the detection of specific antigen-receptors (SAR) on lymphocytes by using monoclonal anti-idiotypic antibodies to hemorrhagic fever with renal syndrome (HFRS) virus as probes and the expression of SAR on lymphocytes from HFRS patients was studied. The results showed that SAR-positive lymphocytes appeared in acute phase, reached to the peak in urorhagia phase, declined gradually in recovery phase, and almost disappeared after recovery. As SAR on lymphocytes can be expressed in HFRS early phase, the detection of these receptors is significant for early diagnosis of HFRS.

Expression of Human TGF- α -Galactosidase Fusion Gene in Insect Cells With a Baculovirus Vector

40091006F Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 22 No 6, Nov 90 pp 563-569

[English abstract of article by Li Yiping [2621 0076 1627], Li Mintang [2621 2404 2768], et al., of the Shanghai Institute of Biochemistry, Academia Sinica, Peng Sufen [1756 4790 5358] and Xu Yonhua [1776 3057 5478] of the Shanghai Institute of Cell Biology, Academia Sinica]

[Text] A TGF- α / β -galactosidase fusion gene has been inserted into the baculovirus (AcNPV) transfer vector pUAc-5 to construct plasmid pUATL-8. Through cotransfection of insect cells (Sf) with pUATL-8 and wild type AcNPV genomic DNA, the recombinant virus VAG-1 was selected as blue plaques in the presence of Xgal. The amounts of TGF- α / β -galactosidase fusion protein produced from Sf cells infected with recombinant viruses at a level of 12 percent of total stainable proteins and about $150 \mu\text{g}/10^6$ cells β -galactosidase.

The Conformation of Lipid-Vesicle-Bound Cytotoxin MT-B

40091006G Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 22 No 6, Nov 90 pp 583-591

[English abstract of article by Zou Zhiyang [6760 1807 2254], Wang Jingying [3076 7234 5391], and Lu Zixian [7627 1311 6343] of the Shanghai Institute of Biochemistry, Academia Sinica]

[Text] A high concentration complex of cytotoxin MT-B from *Naja naja atra* with phospholipids was made and detected for ^1H NMR spectra at 400 MHz and far-ultraviolet circular dichroism spectra. Comparative studies of the spectra for pure cytotoxin MT-B and those for its complex provide evidence that conformational changes had taken place in the MT-B molecules. The assignment of ^1H NMR spectra showed that the chemical shifts of methyl group protons of Ile39 shifted more than 0.48 ppm to low-field. The four α protons of Tyr22, Cys21, Cys38 and Cys53 shifted on an average more than 0.94 ppm to high-field. It was determined by the space model of MT-B and "Isoshielding" line in the neighborhood of a benzene ring that the distances of these protons to aromatic rings were 1.8 Angstroms and 4 Angstroms farther than in free MT-B. The ellipticity of the CD spectrum in 200-250 nm increased in general. The positive CD extrema at 223 nm apparently increased, indicating the change of environment around Tyr22. The ellipticity at 200 nm also apparently increased. On the contrary, the negative CD extrema at 208 nm showed almost no change. The conclusion may be drawn that some significant changes in secondary structure must have occurred when MT-B bound to phospholipid vesicles.

Cloning and Overexpression of the Restriction Gene of EcoRI

40091006H Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 22 No 6, Nov 90 pp 599-606

[English abstract of article by Yang Xiangjiao [2799 7449 1293], Chen Changqing [7115 1603 1987], Wang Debao [3769 1795 1405] of the Shanghai Institute of Biochemistry, Academia Sinica, Yang Shengli [2799 0524 0448] and Wu Ruping [0702 5423 1627] of the Shanghai Institute of Pharmacology, Academia Sinica]

[Text] Cloning and expression of the EcoRI genes are reported here. A plasmid containing the EcoRI (r/m) genes was extracted from the EcoRI producing strain *E. coli* RI, and a 4.9kb BamHI-HindIII fragment encoding the EcoRI genes was cloned into pBR322, producing a hybrid plasmid pER101. pER302, containing the methylase gene of EcoRI, was obtained by inserting the 1.7kb fragment from pER101 into pACYC184. pER304, in which the sequence coding for the C-terminal of EcoRI was downstream from the λP_i promoter, was constructed from pAS1 and pER101. After cloning the 1.5kb SII-BglII fragment of pER101 into pER304, a EcoRI overproducing plasmid pER306 was created using the strong promoter P_i as well as the endogenous promoter P_e to overexpress the EcoRI(r) gene. To delete the P_e promoter to control expression of EcoRI only by the P_i promoter, a 0.65kb BamHI-HindIII fragment from pER401 was used to replace the small BamHI-HindIII fragment downstream from the P_i promoter, resulting in another overproducing plasmid pER307. When transforming G1139 and G1139/pER302, the relative survival

efficiency of pER306 and pER307 was both 10^{-5} , but when using TGI/pRK248CIts and GI139/pER302 as hosts the efficiency was 10^{-5} and 1 respectively. Therefore, in certain hosts, pER307 can express EcoRI in the absence of its cognate methylase. After heat induction, pER307/[TGI/pRK248CIts] produces EcoRI at a level of 10^5 units per gram of wet cell, which is about 1-2 orders of magnitude lower than that of pER306/[GI139/pER302] or pER307/[GI139/pER302].

Study on Audio-Motor Reaction Under Acute Hypoxia

400910061 Beijing ZHONGGUO YINGYONG SHENGLIXUE ZAZHI [CHINESE JOURNAL OF APPLIED PHYSIOLOGY] in Chinese Vol 6 No 4, Dec 90 pp 344-347

[English abstract of article by Zhang Jingxue [1728 7234 7185], Jia Siguang [6328 0674 0342], Wu Jianmin [2976

1696 3046], and Yu Qingxiang [0060 1987 4382] of the Institute of Space Medical Engineering, Beijing 100094]

[Text] Nine male subjects were tested in a hypobaric chamber simulating 3,000, 4,000, 5,000 and 6,000 m altitudes. All subjects stayed at each altitude for 1 hour and were tested during staying. The test items included auditory examinations as well as EEG and chief complaint. The information obtained from auditory examination was processed by computer. The results indicated that the audio-motor reaction of the subjects was basically normal at 3,000 m, while the correct rate, missing rate, delayed reaction rate and reaction time of audio-motor reaction changed distinctly at 5,000 m and 6,000 m. These results may provide an ergonomic reference for establishing physiological standard in protection against acute hypoxia.

TRANSCUBE: Hypercube Multiprocessor System

91P60112 Shenyang XIAOXING WEIXING JISUANJI XITONG [MINI-MICRO SYSTEMS] in Chinese Vol 12 No 1, Jan 91 pp 26-31, 46

[Article by Xu Chengzhong [7312 2052 1813] of Shantou University and Zhang Defu [1728 1795 1381] of Nanjing University: "TRANSCUBE: a HypercubeStructure Multiprocessor System"]

[Abstract] TRANSCUBE (TRANSpouter+hyperCUBE) is a DMMP (distributed memory message-passing) MIMD (multiple-instruction-stream/multiple-data-stream) parallel-processing system we have developed, based upon well-known foreign-made systems including the Intel ipsc, the Mark III, the NCUBE, the CM-2, the Ametek System25, and the FPS T-series. Our hypercube system is built around an array of eight processing elements (PEs), each of which is an INMOS T414 transputer (one 32-bit processor, 2K on-chip memory, controller, and four I/O ports; nominal data transfer rate of 10Mb/s, actual data transfer rate of 430Kbytes/s) plus a 1MBbyte memory on a separate chip. The eight PEs make up the bottom layer of the three-layer TRANSCUBE structure; the middle layer consists of an interface buffer controller (IBC), itself a PE; and the top layer is the host, a PC AT microcomputer. Hardware also includes the TSB98-9 system board manufactured by the British firm Transtech [Devices Ltd.]; this board has nine PEs and one programmable 32 x 32 electronic switch.

The TRANSCUBE communications software structure consists of three parts: host-IBC communications, IBC-processor array communications, and communications between the individual PEs in the processor array. This last part, or inter-PE communications, has a four-layer protocol: a physical link layer, a data link layer, a network layer, and an application layer.

Since TRANSCUBE uses the DMMP technique, it is easy to expand the eight-PE system into a larger array. A schematic of the present eight-PE system, with broadcast bus, is shown in Fig. 7 [Figs. 1-6 not reproduced].

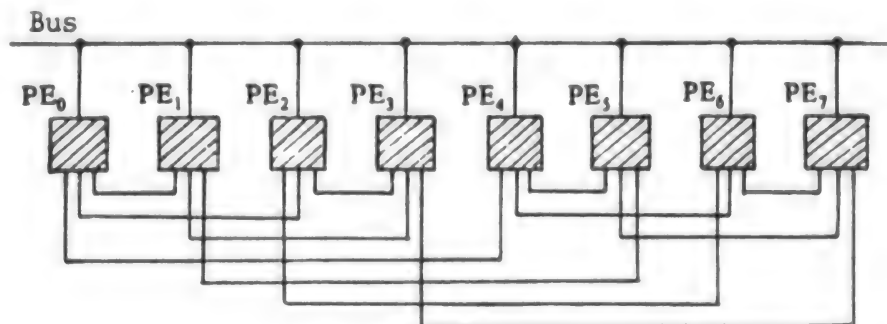


Figure 7. Hypercube Structure With Broadcast Bus

References:

- (1) Kai Hwang and F.A. Briggs, "Computer Architecture and Parallel Processing," McGraw-Hill Book Co., 1984.
- (2) E. Organick and Kay Asbury, "The ipsc Stress Tester (Organick Kaspberry)," The First Conf. on Hypercube Multiprocessors, 1985.
- (3) C.L. Seitz, "The Cosmic Cube," CACM, Dec. 1984.
- (4) J.C. Peterson, "The Mark III Hypercube—Ensemble Concurrent Computer," Proc. of International Parallel Processing, 1985.
- (5) J.F. Palmer, "A VLSI Parallel Supercomputer," The First Conf. on Hypercube Multiprocessors, 1985.
- (6) W.D. Hillis, "The Connection Machine," Cambridge, MA: MIT Press, 1985.
- (7) T.H. Dunigan, "Hypercube Performance," Proc. 2nd Conf. on Hypercube Multiprocessors, 1987.
- (8) D. Bergmark, J.M. Francioni et al., "On the Performance of the FPS-TSeries Hypercube," Proc. 2nd Conf. on Hypercube Multiprocessors, 1987.
- (9) "The Transputer Family," INMOS Product Information, 1986.
- (10) E.N. Gilbert, "Gray Codes and Paths on the N-Cube," BELL SYSTEM TECH.J., 37, 1985.
- (11) S.R. Deshpands, R .M. Jenevein, "Scalability of a Binary Tree on a Hypercube," Proc. of International Parallel Processing, 1986. (12) Transtech Devices Ltd., TSB 94/98 Technical Note, 1987.

Anti-Virus Hard-Disk Protection Device Developed

91P60110A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 12 Jan 91 p

[Article by Zhou Axin [0719 7093 2946]: "Breakthrough in Anti-Computer Virus Technology: Hard-Disk Protection Device Is New Bodyguard for Microcomputers"]

[Summary] The CAS Science & Technology Policy and Management Science Institute recently developed a microcomputer hard-disk hardware controller with a "write-enable" function. The anti-virus hard-disk protection device permits the copying of data files between the hard disk and on-board RAM without the danger of spreading the virus to the hard disk, and thus also protects floppy disks made from the hard disk. The new device has yielded beneficial results in tests at Qinghua University and at MPT's Design Institute.

Special Report on Information Technology/ Optoelectronics in 863 Plan

Overview

91FE0036A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Sep 90 p 2

[Article by Xu Xiaodi [1776 4607 2769]]

[Text] Information technology is an important area in the 863 Plan. It consists of three major subjects: intelligent computer systems, optoelectronic device and microelectronics and optoelectronics integration technology, and information acquisition and processing technology. Information technology is the most active field which stimulates technical, economic and social progress and improves quality of life. The level of research, development and application of information technology has become a major indicator used to gauge the extent of development of a country. The three major strategic objectives in information technology are: Intelligent computer systems—Put our best people and resources in advanced computer technology and artificial intelligence together to track the latest developments in advanced computer technology and artificial intelligence in the world, investigate the theoretical basis and key technology of intelligent computers, and promote the widespread use of artificial intelligence in order to push for the establishment of an intelligent computer industry in China. Optoelectronics systems—Develop all kinds of novel optoelectronic devices and associated system integration technology for sensing, computing and communications, and explore new ways to fabricate VLSI circuits in order to lay a good technical and material groundwork for new information acquisition systems, computers and communications equipment. Information acquisition technology—Develop a

variety of information acquisition and processing technologies to meet industrial and agricultural needs. The key areas include infrared detection, adaptive optical telescopes, imaging radar technology and high-speed real-time signal-processing technology. The status of information technology is briefly presented as follows: (1) Expert responsibility system—An expert responsibility system is used to manage information technology. Each of the three major subjects has an expert group to provide leadership and organization for research activities. Members of the expert groups were recommended by relevant departments in the national government, and reviewed and appointed by the expert appointment committee of the State S&T Commission. Finally, their appointments were approved by the State S&T Commission. Every 2 years, in principle, one third of the members will be replaced. The second term, with 23 members, has already begun. (2) Open solicitation of subjects—As for the determination of research subjects, the Expert Group issues solicitation guidelines and accepts applications from all over the country. The applications are reviewed and selected. Under investigation are 272 subjects involving approximately 2,400 technical people and 77 research institutes and higher-learning institutions. (3) Building a research center—The 863 Plan is implemented based on a "goal-driven" principle. As far as information technology is concerned, the development of target products and research on key technologies require highly sophisticated equipment and facilities (such as ultra-clean rooms) and the talents of many outstanding scientists and engineers. Under the circumstances, we must concentrate our investment to gain an edge in the working environment and human resources. The way to do it is to build a "research center." In the past 3 years, we have built two such centers: the Intelligent-Computer R&D Center and the Optoelectronics Technology Center. These two centers have a higher level of working conditions for developing target products in their respective fields. They are open to specialists nationwide and support a variety of research topics. (4) Accomplishments—A number of significant accomplishments have been obtained in information technology in the past 3 years. Ninety-eight projects, including the study of infrared focal-plane-array technology, integrated modular optical terminals for fiber-optic communications, and the EST/IS4260 intelligent workstation, have been successfully completed; 22 projects have reached a world-class level and 12 projects are in widespread use. Specifically, the projects are summarized below.

Accomplishments in Information Technology

Subject	World level	Domestic leader		Intermediate results	Design finalized	Disseminated applications	Total
Intelligent computing	12	35		21	21	5	47
Optoelectronics	7	31		33	3	2	38
Information acquisition & processing	3	10		8	0	5	13
Total	22	76		62	24	12	98

Information Acquisition, Processing Technology

91FE0036B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Sep 90 p 2

[Article by Kuang Dingbo [0562 1353 3134]]

[Text] In order to satisfy the demand in areas such as intelligent industrial automation, survey of resources, weather forecasting, monitoring of the environment, ocean and forests, and product quality control, a number of information acquisition and processing systems have been developed. The key areas include infrared detection, adaptive optical telescopes, imaging radar technology and high-speed real-time signal-processing technology. Considerable progress has been made in the study of infrared materials, fundamental theory and applications. Among various means to obtain distant target information by electromagnetic waves, the optical method has its unique advantages, including very high resolution. However, due to effects such as atmospheric turbulence, the resolution of a large-aperture telescope is no higher than that of a 0.1 or 0.2-m-diameter telescope. An adaptive telescope solves this problem. Adaptive optical telescope technology has been successfully tested in the laboratory. The major subjects in the entire area of information acquisition and processing are divided into several research projects. There are over 70 such projects under investigation involving almost 30 organizations including the Chinese Academy of Sciences (CAS), the Ministry of Machine-Building and Electronics Industry (MMEI), the Ministry of Aerospace Industry, and the State Education Commission. The expert group, selected by the State S&T Commission, consists of nine outstanding young and middle-aged scientists with excellent academic achievements, good political beliefs and strong organizational skills. The group leader is Kuang Dingbo, Director of the CAS Shanghai Institute of Technical Physics (SITP). The expert group members are appointed for a term of 2 years with an option to be reappointed. The expert group manage the overall activities of the subject. The day-to-day affairs are handled by the subject office. The management of each contractor should appoint a dedicated point of contact to maintain routine contact with the subject office to ensure open communications between the State S&T Commission, the expert group (office) and the project (management of contractor performing the research project).

Intelligent Computer Technology

91FE0036C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Sep 90 p 2

[Article by Wang Chengwei [3076 2052 3634]]

[Text] Computers have changed and are still changing the way we live. Advanced computer technology usually reflects the level of S&T development of a nation, and is also extremely important to a nation's prosperity and strength. China is placing a great deal of emphasis on the development of advanced computer technology and artificial intelligence (AI) technology. These two subjects

comprise a major area in the national high-technology plan: the intelligent computer systems topic, for which an expert group has been established. The main objectives of this group are to pool our best people and resources in advanced computer technology and AI together, to track the latest worldwide developments in advanced computer technology and AI, to investigate the theoretical basis of and key technologies for intelligent computers, to promote the widespread use of AI, to push for the establishment of an intelligent computer industry in China, and to strengthen international cooperation in advanced computer technology and AI. To this end, based on over 2 years of research, analysis and experience, as well as on objective conditions such as projected investment level, personnel qualification and technical foundations, the intelligent computer expert group drafted the "Intelligent Computer Systems R&D Plan." The core of the plan is "four principles, two levels and one goal." The four principles are: (1) Pay attention to research on key technologies and basic theory. As we selectively follow advanced technology throughout the world, we should also encourage innovation and speed up personnel training. (2) Address R&D of applied systems. We should encourage the combination of traditional technology with new technology in order to raise the overall benefits of AI. (3) Stress accomplishments in phases and convert them into high-tech products. We should establish a linkage with major information products and make complementary products. (4) Attach importance to exchanges and cooperative efforts. We should encourage international joint R&D activities and strengthen cooperation among open laboratories, research centers, research institutes and higher-learning institutions in China. A unified, orderly, competitive and mutually complementary network of cooperation should be established.

The "two levels" signify that arrangements in each phase are to be made in two steps. The first level is to conduct research on key technologies of the present phase to complete the development and integration of target products or individual objectives. The purpose is to provide some prototypes for production and field use. The second level is to perform key-technology research for the next phase and conduct initial studies on other necessary subjects. The purpose is to prepare for the technical objectives in the next phase.

Finally, the "one goal" is a development concept. Our work is to develop advanced computer technology for AI systems. As the research progresses to deeper and deeper stages, theoretical and technical breakthroughs will be made to allow us to develop our own intelligent computer systems by 2000. These will be functionally distributed systems, whose major special features will include computation, perception, memory, inference, and learning capabilities. They will have a harmonious interactive man-machine environment that can handle modes such as Mandarin speech, Chinese characters, graphics, and images. Software design for these new

systems will be abundant and geared to production capacities and to the development of intelligent application systems.

In order to achieve the strategic objectives set up in different stages in the plan, the intelligent computer system expert group established a research and development plan which includes the national intelligent computer R&D center, research points and subject group. The intelligent computer R&D center was established in March 1990. Its main assignments are to perform key product development and system integration given by the expert group, to gradually build an 863 Plan intelligent computer laboratory open to outside researchers, to develop relevant individual technologies and some basic research, to organize academic exchanges, and to train specialists. The center is under the jurisdiction of the CAS Institute of Computing Technology. The research network points are entities for implementing the development of key technologies and target products as assigned by the expert group. We are in the process of establishing a systems network, software network, intelligent-interface network, applications network and basic research network. The subject group is the basic research organization implementing this plan, and performs research projects assigned by the expert group. There are over 40 universities and 30 research institutes under CAS or under industrial departments conducting 140 AI research projects on a contract basis. They are scattered over 15 provinces, cities and autonomous regions. The subjects in the current phase include intelligent computer system structure; development of intelligent software and automated production of software; intelligent interfaces involving sound, graphics, images, and words; and basic theory involving intelligent applications systems and intelligent computer systems. After over 2 years of effort, as of August 1990, 47 research projects have been certified, among which 21 projects have borne phased [i.e., initial or middle-term] results and 26 projects have achieved final results; 28 projects have reached or approached the world state-of-the-art as of the mid-to-late eighties. For example, the "EST/IS4260 intelligent workstation system," developed by the CAS Institute of Computing Technology and other units organized by the expert group, filled a void in RISC workstations in China. This key target product in phase I of the intelligent computer plan has technical specifications matching those of similar foreign-made products of the late 1980's. In addition, a prototype machine with a level-2-standard vocabulary (6763 characters) for recognizing and processing printed Chinese characters and other documents with a 99-percent character-recognition accuracy and a recognition speed of 50 characters/second for ordinary books has been completed. A Chinese-speech-recognition/processing system with a 40,000-phrase vocabulary, 99-percent accuracy, and near-real-time capability is already on the market. A census-form reader has already been used in the fourth census.

Optoelectronics Technology

91FE0036D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Sep 90 p 2

[Article by Zhou Bingkun [0719 3521 3824]]

[Text] Due to breakthroughs since the mid-seventies in semiconductor optoelectronic device technology and fiber-optic technology, an information optoelectronics technology and industry has been rapidly established by combining optoelectronics with electronics. Optoelectronics technology, represented by fiber-optic communications, optical storage, optical computing, and optical sensing, is growing at a rapid pace, and plays an important role in many areas in the economy. Furthermore, it is has matured to become a pillar of our information society in the future. A new optoelectronics industry is being formed. It is generally believed that if the 20th century is the era of electronic information, then the 21st century will be the era of optoelectronic information. Our seasoned scientists have also commented on optoelectronics technology. Wang Daheng [3769 1129 2709] pointed out optoelectronics technology is an active area of new technology and has bright prospects. If the number of unique features of optics is A and that of electronics is B, then the overall usefulness of combining optics with electronics is not $A+B$, but rather $A \times B$. In optical communications, optoelectronics technology plays a major role. Fiber-optic cable is replacing coaxial cable in communications. Optical computers have some capabilities (such as image processing and intelligent computation) that electronic computers cannot match. In recent years, major breakthroughs such as superlattice and quantum-well technology have been made in optoelectronics technology, and a large number of new results are expected in the field in the near future. Since the basis for developing optoelectronic information systems is optoelectronics device and integration technology, this topic was chosen as a major item in information technology in the nation's high-technology R&D plan. It includes the following: An optoelectronics technology center; technology for key optoelectronic devices and components used in high-speed, high-capacity optical communications; optoelectronic devices, individual technologies and integration capability used to link electronics with optics in computers; two-dimensional optical-computing technology and its associated key optoelectronic devices; integrated optoelectronics technology and integrated optics technology; research on novel optoelectronic devices and processing technology; and research on dedicated optoelectronic devices and systems technology. The optoelectronic device and microelectronics integration expert group completed the confirmation of the above strategic objectives after 3 years of work, and arranged seven special topics and close to 80 research projects. This is an important step for high-technology research. Chinese scientists have been responsible for over 40 accomplishments in various stages; some results are very innovative or close to world-class levels. The technical staff is fighting vigorously on the front line of high technology based on the

spirit of "justice, devotion, realism, cooperation and innovation" for a bright future.

Optoelectronics Research

91FE0036E Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Sep 90 p 2

[Unattributed article]

[Text] Good progress has been made in the past 3 years in research projects on optoelectronic devices and integration technology associated with microelectronics and optoelectronics. In over 90 percent of the projects, the objectives set for the Seventh 5-Year Plan have been met. In 20 percent of the projects, significant progress has been made and innovative results seen. Over 40 intermediate accomplishments have been made and seven of them are either at a world-class level or constitute major innovations. These results can be summarized in five areas. (1) Near-term contributions to the main battlefield. The most representative products are the 140 Mbit/s [DS4] hybrid integrated optical terminal and the 622 Mbit/s hybrid integrated-component module and distributed feedback (DFB) laser diode. During the development process, importance was attached to close contact between end users and manufacturers. From design to development, user requirements were considered fully. The result of the hybrid integrated optical terminal can be widely used in the 140 Mbit/s fiber-optic-communications terminals to produce a new generation of products. Furthermore, it may replace imported products used in our imported production lines. (2) Novel optical communications devices. This category of results includes a 1.5-micron-wavelength single-mode narrow-line-width tunable semiconductor laser, a semiconductor travelling-wave optical amplifier, an Er-doped glass fiber amplifier, a lithium-niobate optical-waveguide high-speed modulator, a 1.1-1.6-micron-wavelength high-speed APD [avalanche photodiode] detector, and duplex frequency-division-multiplexing coherent optical communications technology. (3) Breakthroughs have been made in quantum-well optoelectronic devices: Low-threshold-current multiple-quantum-well (MQW) laser diodes with excellent temperature characteristics and GaAs/AlGaAs quantum-well superlattice self-electro-optic-effect devices (SEEDs) have been developed. (4) Optoelectronic integrated circuits (OEICs) have been made for the first time domestically. A 250-mw-power integrated laser diode array that combines a GaAs monolithic integrated optical emitter and a SiPIN-FET [silicon positive-intrinsic-negative field-effect-transistor] monolithic integrated optical receiver has been preliminarily developed. Major progress and innovation have been made in exploring the compatibility of integration processing. (5) New progress has been made in studying optical computing devices: particularly significant progress has been made in preliminary studies on basic devices, testing methods and individual technologies associated with optical computing. Superlattice growth

of II-VI semiconductors (ZnS-ZnSe/GaAs) and fabrication of optically bistable devices have been demonstrated. A bismuth-silicate spatial light modulator (SLM) has been made in China and is being sold in other countries on a trial basis. GaAs has been successfully grown on Si by MBE (molecular beam epitaxy), and GaAs/Si LEDs and MESFETs [metal-semiconductor field-effect transistors] have been successfully fabricated. These research activities have laid a solid foundation for the development of new optoelectronic-communications products to meet our urgent domestic need and to compete on the worldwide market in order to achieve the strategic goal of this subject matter.

Roster of Expert Group Members

91FE0036F Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Sep 90 p 2

[Unattributed article]

[Text] Intelligent Computer Expert Group: Wang Chengwei [3076 2052 3634], Research Fellow, Expert Group Leader, Institute of Systems Engineering, Commission of Science, Technology & Industry for National Defense (CSTIND); Zhang Xiang [1728 4382], Research Fellow, Assistant Expert Group Leader, Institute of Computing Technology, CAS; Li Wei [2621 2607], Professor, Assistant Expert Group Leader, Beijing Aerospace University; Dai Ruwei [2071 3067 3634], Research Fellow, Assistant Expert Group Leader, Institute of Automation Technology, CAS; Sun Zhongxiu [1327 6988 4423], Professor, Expert Group Member, Nanjing University; Wang Dingxing [3769 7844 5281], Professor, Expert Group Member, Qinghua University; Li Guojie [2621 0948 2638], Research Fellow, Expert Group Member, Institute of Computing Technology, CAS.

Optoelectronics Expert Group: Zhou Bingkun [0719 3521 3824], Professor, Expert Group Leader, Qinghua University; Chen Lianghui [7115 5328 1920], Research Fellow, Assistant Expert Group Leader, Institute of Semiconductors, CAS; Zhang Yimo [1728 0110 6206], Professor, Expert Group Member, Tianjin University; Wang Qiming [3769 0796 2494], Research Fellow, Expert Group Member, Institute of Semiconductors, CAS; Liu Shiyong [0491 1709 1066], Professor, Expert Group Member, Jilin University; Liang Chunguang [2733 2504 1639], Senior Engineer, Expert Group Member, Research Institute No 13, MMEI; Chen Xueliang [7115 1331 5328], Associate Research Fellow, Expert Group Member, Shanghai Institute of Metallurgy, CAS.

Information Acquisition Expert Group: Kuang Dingbo [0562 1353 3134], Research Fellow, Expert Group Leader, SITP, CAS; Yang Zhenming [2799 2182 2494], Research Fellow, Expert Group Assistant Leader, Luoyang Institute of Metrology and Communications; Liu Yongtan [0491 3057 0982], Professor, Expert Group

Member, Harbin Institute of Technology; Liang Dian-nong [2733 3949 6593], Professor, Expert Group Member, Changsha Institute of Engineering; Jiang Wenhan [1203 2429 3352], Research Fellow, Expert Group Member, Institute of Optoelectronic Technology, CAS; Yang Jiade [2799 1367 1795], Research Fellow, Expert Group Member, Chongqing Institute of Optoelectronic Technology; Hou Chaochuan [0186 2600 3562], Research Fellow, Expert Group Member, Institute of Acoustics, CAS; Zhang Guangyi [1728 0342 5030], Senior Engineer, Expert Group Member, Nanjing

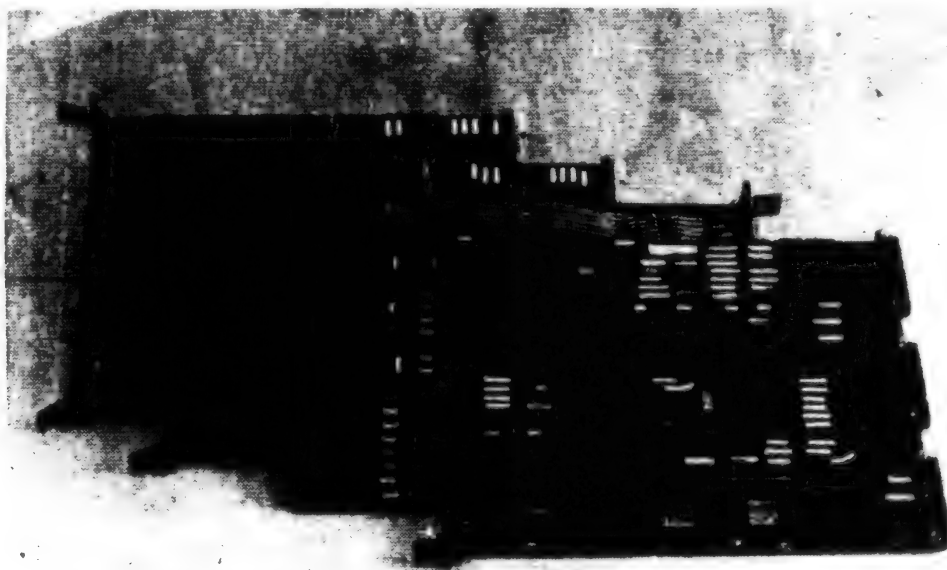
Institute of Electronic Technology; Wei Zhongquan [7614 6988 6898], Research Fellow, Expert Group Member, Shanghai Institute of Satellite Engineering.

Photograph Captions

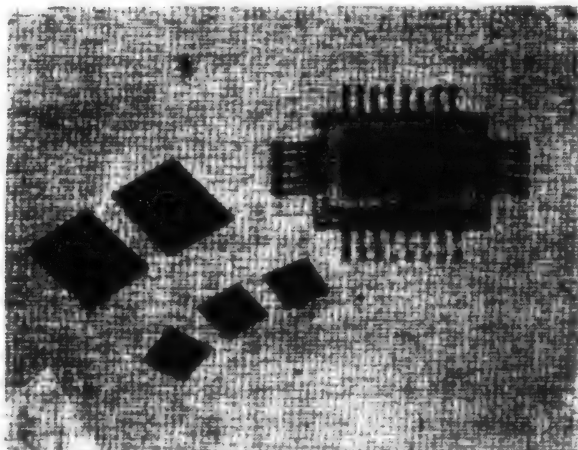
91FE0036G Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Sep 90 p 2

[Photograph captions]

[Text]



Major Components of Intelligent Workstation Developed by the Intelligent Computer Expert Group



The Most Promising Low-Cost Mid-Infrared Focal-Plane-Array Device, Consisting of 256x256 Elements, the Highest Level of Integration for Such a Device Achieved in China

First Domestic IC CAM System Developed

91P60101 Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 30 Dec 90 p 1

[Article by Hua Shi [5478 1395] and Chen Shuxin [7115 3412 2450]: "Integrated-Circuit Computer Aided Manufacturing System Developed"]

[Summary] On 15 December 1990, China Huajing Electronics Group announced that a 2-year-plus effort of over 100 of its scientists and engineers to develop the nation's first independently designed integrated-circuit computer aided manufacturing (IC CAM) system has met with success, and furthermore that the system has passed ministry-level technical appraisal.

System performance, according to the experts at the technical appraisal, matches that of foreign-made products of like variety. Making up the entire system are ten subsystems—planning, production management, process technique, quality [control], economics, operations, materials, plate making, statistics, and system management. All process technique and manufacturing files and data can be stored on a computer, creating a paperless management system resulting in improved yield (via a prompt statistical analysis of faulty or poor-quality sample ICs), reduced production lead times, and greater



Ultra-Clean Room at the Optoelectronics Technology Center

worker productivity. The experts estimate that Huajing Electronics Group's own application of this system over a year's time can generate added benefits to the group of over 10 million yuan.

Multi-Font, Multi-Symbol Chinese-Character Recognition System, High-Speed Reader Developed

91P60110B Beijing JISUANJI SHIJI [CHINA COMPUTERWORLD] in Chinese No. 3, 16 Jan 91 p. 1

[Article by Hai Ping [3189-5493]. "Multi-Font, Multi-Symbol Chinese-Character Recognition System: High-Speed Chinese-Character Reader At Advanced Level", cf. JPRS-CST-91-004, 5 Feb 91, pp. 14, 16]

[Summary] Two new practical Chinese-character recognition systems that can handle various fonts, alphabets, numbers, and other symbols have simultaneously passed the expert technical appraisal given in Qinghua Park recently. The first system, called THOCR-90 by its developers at Qinghua University's EE Department, runs on a PC and can recognize about 4000 different printed Chinese characters with an accuracy of over 98 percent; it is intended for use with the variety of typefaces encountered in different books, magazines, and newspapers. The second system, a multifunctional Chinese-character recognition system developed by the CAS Shenyang Institute of Automation, consists of a 386-33 microcomputer, a scanner, and recognition software. It can recognize texts in any of three popular fonts and

employs neural-network technology for pattern matching. Recognition speed is about 30 characters per second, and recognition accuracy has exceeded 96 percent for a single typeface. Also passing appraisal was the NK-II high-speed Chinese-character reader developed by Nankai University. This system runs on a 16MB AT microcomputer, has a recognition speed of over 45 characters per second, and has a recognition accuracy of over 97 percent when used with fairly good quality texts set in a single typeface.

Further Advances in Printed-Chinese-Character Recognition Technology

91P60110C Beijing JISUANJI SHIJI [CHINA COMPUTERWORLD] in Chinese No. 3, 16 Jan 91 p. 1

[Article by Han Yun [7281-0001]. "Printed-Chinese-Character Recognition System Reaches Practical Stage"]

[Summary] The printed-Chinese-character recognition system developed by MPT's Data [Processing] Institute passed appraisal at the beginning of the year. This system, which utilizes the "quadrant-character-stroke characteristic method" and which incorporates fuzzy logic in its categorization, aims in order to handle imperfect texts. It consists of a text graphics scanner and any of a variety of microcomputers. The system can recognize the GB-1 and GB-2 levels of Chinese characters with an accuracy of over 95 percent and a speed of 2200 characters per second.

Military Fuzzy-Logic-Based Pattern Recognition System Developed

91P60110D Beijing JISUANJI SHIJIE [CHINA
COMPUTERWORLD] in Chinese No 3, 16 Jan 91 p 1

[Article by Chang Gong [7022 1562]: "Technology, Algorithms for PrintedBoard Logic Diagram/Manuscript Pattern Recognition Inputting System Demonstrate New Ideas"]

[Summary] The printed-board logic diagram/manuscript pattern-recognition inputting system developed by the Computer Research Institute of the University of S&T for National Defense passed expert appraisal the other day in Changsha. This system, which utilizes fuzzy relations among text areas, has demonstrated an accuracy of 97.3 percent when used to recognize printed-board logic diagrams. The system, whose routines are written in C, can also recognize manuscripts written in large characters and numbers; with proper training,

accuracy can reach 98.95 percent with a speed of 912 characters per minute (tested with an IBM PC 286).

First Domestic Transplant of UNIX System V

91P60110E Beijing JISUANJI SHIJIE [CHINA
COMPUTERWORLD] in Chinese No 4, 23 Jan 91 p 1

[Article by Du Cai [2629 6846]: "First Successful Domestic Transplant of UNIX System"]

[Summary] The CAS Software Institute in a 2-year-plus effort, has carried out the first successful domestic experimental transplant of the entire UNIX System V: the UNIX System V R3.1 source code from an AT&T 3B2-series computer has been transplanted to a VAX 11/750, with no loss of normal operation. The researchers used cross compiler techniques and reverse engineering methods in this system software development project, which also included transplanting of the top layers of UNIX System V R3.1 from the 3B2 computer to a 386 computer operating under the XENIX system.

Developments in CNC Machine Tools, FMS Technology Reported

Second National FMS Conference Held in Dalian

91FE0139A Dalian ZUHE JICHUANG YU ZIDONGHUA JISHU [MODULAR MACHINE TOOL AND AUTOMATIC MANUFACTURING TECHNIQUE] in Chinese No 10, Oct 90 p inside front cover

[Article by Xu Jiamo [1776 0857 2875]

[Text] China's Second National FMS [flexible manufacturing systems] Conference (FMS'90) was held on August 16-21, 1990 in Dalian and it was a success.

Based on a decision made at the first FMS conference, it was sponsored by the machinery-industry automation division of the Chinese Mechanical Engineering Society (CMES). Other co-sponsors include the machining division of the Chinese Munitions Industry Association, the manufacturing systems committee of the manufacturing engineering division of CMES, and the National Association of Automatic Machining Research among Institutions of Higher Education (NAAMRIHE).

The host for the conference, attended by 101 delegates from 14 provinces and cities, was the Dalian Modular-Machine-Tools Research Institute (DMMTI). These delegates came from 55 units, including 22 higher-learning institutions, 10 research institutes, 19 factories and enterprises and 3 publishing organizations. The Office of Machine Tools in the Ministry of Machine-Building and Electronics Industry (MMEI) also sent representatives.

Ninety papers presented at the conference were reviewed and recommended based on originality, practicality and innovativeness. Finally, an academic committee formed by experts selected 19 outstanding papers. The contents of these papers primarily cover 8 areas: (1) general discussions of FMS and CIMS [computer integrated manufacturing systems], (2) system design and simulation, (3) FMS control and management systems, (4) computer numerically controlled (CNC) machining systems, (5) testing and monitoring, (6) automatic material-transport systems, (7) CAD, CAPP and CAM [computer-aided design, computer-aided process planning, and computer-aided manufacturing, respectively], and (8) computer networking and communications.

The viewpoints in these papers and the associated flexible technology equipment essentially represent the level and direction of development of flexible manufacturing technology in China. The delegates also visited DMMTI and the Dalian Machine Tools Plant. Their accomplishments in flexible manufacturing technology in the Seventh 5-Year Plan left a deep impression upon all the delegates. A technical accomplishment announcement meeting was arranged during the conference to introduce software and hardware products to the end users. In addition, special-topic discussions were also held. The following opinions were raised.

1. FMS technology has matured in other countries; it is being developed rapidly, mostly for machining of box-shaped parts [i.e., casings] and secondarily for machining of solids of rotation and of sheet metal. In China, this technology has just gotten underway and needs further research and development.

2. FMS technology is being used in a cautious manner in other countries and the scale is also limited. Developing medium and small economical-type FMSs is the right way to go for China.

3. Reliability is an important aspect in an FMS. Systems made in other countries have more powerful testing and monitoring capabilities. This kind of technology is still not available in China. We should pay special attention to sensor research.

4. Domestic high-performance CNC apparatus cannot meet the requirements for major machine tools. Some elements have to be imported. The key is VLSI technology for integrated circuits. It is correct to focus on [chip-intensive] numerical control in the Eighth 5-Year Plan.

5. Funds for research and development are limited. It is recommended that the government properly support small units which are highly motivated and have a chance to succeed.

6. It is recommended that suitable policy be drafted to improve the pay and working environment of R&D personnel in order to attract good people to ensure the strength of the FMS team.

7. The next FMS conference will be sponsored by NAAMRIHE and will focus on independently developed FMS [production] lines. The site will be determined at a later date.

8. As for establishing a semi-closed FMS joint conference, the following agreement was reached:

(1) The machining division of the Chinese Munitions Industry Association, the manufacturing engineering committee and the production systems committee of CMES, as well as CMES's machinery-industry automation division and machining automation committee, the manufacturing technology division of the Chinese Electronics Society, NAAMRIHE, and the National Committee for Mechatronics Research among Institutions of Higher Education will be the original sponsors. (2) Each organization will appoint one person to join the contact group, and a point-of-contact person in charge will be appointed. (3) New members will be accepted. (4) Charters will be drafted. It will be registered with the science association in order to begin normal communications and academic activities.

Domestic NC Machine Tool CAD Software

91FE0139B Beijing JICHUANG [MACHINE TOOLS]
in Chinese No 10, Oct 90 p 2

[Article by Chang Ming [7022 2494]]

[Text] A sub-topic under the "Development of CAD systems for CNC machine tools," i.e. "software to predict static and dynamic characteristics of machine tools and to improve their structures," was carried out by Beijing Institute of Machine Tools (BIMT) and Hefei Polytechnical University. After over 2 years of effort, a comprehensive AMTPOS [automatic machine-tool parameter optimization system] software package capable of analyzing structural performance of machine tools and improving and optimizing structural parameters was developed. Its unique features include:

1. The software is innovative; it starts at a higher level, was more difficult to write and involved a tremendous workload. It consolidates a number of related technologies such as joint-surfaces recognition techniques, structure-optimization programs, dynamic data for guide rails and bearings, etc. This is a high-grade integrated CAD software package.

2. The successful development and use of the AMTPOS software package provides an effective tool for predicting the static and dynamic characteristics of the entire unit in the design stage and for engineering analysis to improve and optimize the overall structure. It can better demonstrate the advantages of CAD and raise the level of CAD. It is a giant step toward shortening the lead time for development of new products.

3. The package presents the principle and equations for building a model for layered structures. It successfully established a finite-element model for an entire machining center (MC) to effectively solve the modelling of a complicated structure with layers of joint surfaces.

4. The package innovatively developed joint-surface modelling technology, recognition of weak points, sensitivity analysis, partial structural modification and target parameter optimization. It also has a multi-purpose dynamic graphics display. Furthermore, it also has an interface program. For the first time, a large-scale finite-element program has been combined with a dynamic structure optimization program to form a complete system. The AMTPOS software package is a comprehensive, practical and flexible package.

5. The AMTPOS software package was used to evaluate the XH714 vertical MC and the results were compared to the dynamic experimental data. It was verified that the characteristic frequency of the machine calculated by AMTPOS is less than 15 percent off compared to the measured value. Its dynamic error is below 50 percent. Compared to the data published in China and other countries, it is more accurate and can meet the requirements of design analysis for machine tools.

Domestic Ultraprecision Machining Technology

91FE0139C Beijing JICHUANG [MACHINE TOOLS]
in Chinese No 10, Oct 90 p 2

[Article by Chang Ming [7022 2494]]

[Text] In order to satisfy the requirements for ultraprecision machining equipment used in the machine-building, space, and nuclear industries, BIMT has been developing the "ultraprecision shaft-manufacturing technology" which is a Key State Project. After over 3 years of research and experimentation, breakthroughs have been made. Project results have reached a world-class level and are being used in production.

The accomplishment of ultraprecision shaft-making has resulted in a number of high-precision roundness gauges and ultraprecision machine tools. The gauges can measure roundness, spherical profile and cylindricity. The ultraprecision machine tools can machine and mill parts made of non-ferrous metals and ferrous metals to produce parts such as planar mirrors, spherical mirrors, non-spherical mirrors and other special optical elements (such as molds for Fresnel lenses).

Major technical specifications for the ultraprecision shaft series are that the radial rotation precision is 0.02 μm for roundness gauge shaft, main-shaft load force is 450 N [newtons], axial fluctuation is 0.1 μm for the machine-tool axis series, radial rotation accuracy is 0.1 μm , and radial rigidity is 200 N/ μm .

This technology has been employed to develop the Model JCS-035 ultraprecision CNC lathe. After over half a year of use, it operates normally with reliable precision to machine 120-mm-diameter spherical surfaces. One part is made of hardened aluminum and the cutting tool is made of diamond; profiling (degree of contouring) is 0.5 μm and the surface roughness R_a is 0.09 μm . Another part is made of #45 HB250 hardened and tempered steel, with a hardened-alloy cutter; profiling is 2.2 μm and R_a is 1.36 μm . When used to machine #45 steel plate via a CBN cutter, this machine tool can produce a surface roughness R_a of 0.38 μm .

**BS-7501 High-Performance CNC System
Accredited**

91FE0139D Beijing JISUANJI SHIJIE [CHINA
COMPUTERWORLD] in Chinese No 40, 17 Oct 90 p 1

[Article by Wang Xiren [3769 1585 0088]]

[Text] In order to stimulate the development of CNC machine tools so that the nation might catch up with the rest of the world, the Chinese Academy of Sciences' (CAS) Shenyang Institute of Computing Technology cooperated with the Shenyang No 3 Machine-Tools Plant in a 6-month project to develop a high-performance CNC system, the Lantian-1 (BS-7501), which is comparable to similar products manufactured

abroad in the mid-to-late eighties. This system, accredited by MMEI and by CAS on 26 September 1990, was completely developed, designed and manufactured domestically.

The hardware is totally made domestically and the software is fairly comprehensive. During the development process, special technical features of some foreign products were adapted to improve its technical performance and perfect its capabilities. It has both lathe and milling functions and can be used as a turning center, as a machining center, or as the basic unit in an FMC [flexible machining cell] or FMS. It has a real-time, multi-tasking capability with a multi-CPU structure and can be programmed in different levels to execute multiple machining processes. Each process can control 18 axes and 12 axes can be moved together. The system structure is modular and software and hardware are

flexibly arranged. It can be conveniently organized into a 4, 8, 12 or 16-axis CNC system. Furthermore, it has a very powerful communications capability. Hence, it is an ideal multi-purpose high-performance CNC system.

The accreditation committee believed that the system meets international standards as of the mid-to-late eighties. The BS-7501 can replace imports and is a leading product domestically. The successful development of this product signifies our capability to independently manufacture first-class electronic machinery. Shenyang Institute of Computing Technology and Shenyang No 3 Machine-Tools Plant are now engaged in small-batch production of this system. The individual units are equipped with monitoring devices and a parts and technical maintenance program has been inaugurated to ensure that end-users are provided with continued services for this high-quality product.

Two New Optical Devices Accredited

91P60106a Wuhan HUAZHONG LIGONG DAXUE XUEBAO [JOURNAL OF HUAZHONG (CENTRAL CHINA) UNIVERSITY OF SCIENCE AND TECHNOLOGY] in Chinese Vol 18 No 6, Dec 90 p 144

[Unsigned article: "1.3 μ m InGaAsP Traveling-Wave-Type Low-Noise Linear Amplifier, Optoisolator/Opto-circulator Pass Appraisal"]

[Summary] Two new optical devices—a "1.3 μ m InGaAsP traveling-wave-type low-noise linear amplifier" and "optoisolator/opto-circulator"—developed by researchers in the Fiber Optics Section of our university's Department of Optics as an "863" Program high-tech project passed the expert technical appraisal sponsored by the State S&T Commission and the Hubei Province S&T Commission on 23 September [1990].

The 11-member expert panel, all well-known specialists in optoelectronics and optical communications, noted that the 1.3 μ m low-noise linear amplifier has a pioneering new structure, which has been granted a state patent. The amplifier uses the same optical fiber coupling for both input and output, thereby reducing by one step the number of couplings. Also, the amplifier has two-way gain, serves as an optoisolator when coupled with the opto-circulator, has a manufacturing process quite compatible with that of a semiconductor laser amplifier, and has a performance and main technical indicators that match the international state-of-the-art. The performance of the optoisolator/opto-circulator, which has a single-mode coupled input/output that can handle extraneous polarization, is at the forefront domestically, and its principal technical indicators are at the international state-of-the-art.

1.3-Micron Single-Mode Laser Light Source Developed

91P60113A Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 11 Jan 91 p 1

[Article by Wei Baozhi [7614 0202 5347]: "1.3-Micron Single-Mode Laser Light Source Developed"]

[Summary] The model AV38117 1.3-micron-wavelength single-mode highly stabilized laser light source developed by MMEI's Research Institute 41 recently passed ministry-level appraisal. This new high-output-power laser diode light source incorporates advanced technologies such as automatic optical power control (APC) and automatic temperature control (ATC). Intended for optical fibers, fiber-optic cable, passive optical devices, and insertion-loss meters, this light source meets late-eighties standards for comparable foreign-made devices.

Accuracy of Weak-Magnetic-Field Induction-Density Measurement at State-of-the Art

91P60113B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 11 Jan 91 p 2

[Article by Ji Liang [1323 5328]: "Alternating Weak-Magnetic-Field Induction-Density Standard Established"]

[Summary] The alternating weak-magnetic-field magnetic-induction-density standard established by the China Institute of Metrology recently passed the appraisal sponsored by the State Bureau of Technology Supervision. This standard for electromagnetic compatibility testing is becoming ever more important in the aerospace, military, and scientific research fields. For frequencies up to 1kHz, the recurrent effective value is 0.1 μ T-0.7mT [microtesla and millitesla, respectively], and the accuracy of the alternating weak-magnetic-field induction density unit magnitude is at the international state-of-the-art. The simultaneously developed CCG-1000 alternating-field magnetometer has demonstrated frequency, accuracy, and linearity performance characteristics superior to those of the comparable product made by the Bell [Telephone] Co. in the U.S.

Tungsten-Disk Ar-Ion Laser, Laser Focusing Device Accredited

91P60113C Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 13 Jan 91 p 3

[Article by Chen Zhihao [7115 1807 3185] and Feng Ping [7458 1627]: "Tungsten-Disk Argon-Ion Laser, Laser Focuser Pass Appraisal"]

[Summary] The model A-237 tungsten-disk Ar-ion laser and the model JG-2 TEA [transversely excited atmospheric pressure] CO₂ laser focusing device developed by the Nanjing Electron Tube Plant passed the appraisal sponsored by MMEI a few days ago. The tungsten-disk Ar-ion laser is a new type of ion laser with applications in scientific research (especially spectral research), optical information storage and processing, holography, medical diagnosis and treatment, mobilized-cell fluorimetry, and use of laser microbeams to cut genetic factors. The TEA CO₂ laser focusing device is used to properly concentrate the laser's high-output-energy, large-flare pulsed beam onto the target via a modulation mask and focusing lens arrangement.

New Advances in Optical Thin-Film Research at Institute 11

91P60113D Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 13 Jan 91 p 3

[Article by Li Qiongrui [2621 8825 3843]: "MMEI's Institute 11 Reaps New Achievements in Optical Thin-Film Research"]

[Summary] MMEI's Research Institute 11, known for its work on laser and infrared (IR) technologies, recently announced major new achievements in optical thin-film research. The diamond-like wearproof thin film, IR high-efficiency antireflective coating, and oblique-incidence bandpass optical filter developed by the institute recently passed expert appraisal, at which they were all judged to be at the international state-of-the-art. Using the rf chemical vapor deposition technique on large-surface-area (diameter of over 250mm) optical components, institute researchers deposited a diamond-like film less than 1 micron thick that measures level 8 [topaz] on the Mohs scale of hardness; this film has been utilized in an IR tracking system carried aboard our naval vessels. Institute scientists have also been able to deposit onto a 1-mm-thick germanium wafer an 8-12-micron IR broad-spectrum high-efficiency antireflective coating with an average transmittance exceeding 98 percent in the 7.5-11.5-micron band; this achievement has been incorporated into an IR thermal imaging system, with very positive results. Finally, institute researchers have recently developed a bandpass optical filter that operates normally at both vertical incidence and 45°-angle oblique incidence; filter center wavelength is 900 nanometers, and for 45°-angle oblique incident waves the transmittance is better than 70 percent.

Domestic Advances in Integrated Optics

91P60113E Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
18 Jan 91 p 3

[Article by Peng Jihu [1756 0679 5706], Associate Prof., Qinghua University, Department of Electrical Engineering: "Present State of, Future Hopes for Integrated Optics"]

[Summary] Chinese scientists have been studying integrated optics since the late seventies. CAS research institutes, universities, and industrial research units have achieved several results with lithium niobate materials and with devices for optical communications. Specific examples of the latter include a single-mode pigtail-optical-fiber packaged phase modulator with a 3dB bandwidth of 6GHz, an optical-waveguide intensity modulator with a bandwidth exceeding 5GHz, a 1 x 4 optical-waveguide electro-optic switch-array packaged device for single-mode pigtail optical fibers, and an experimental version of an all-photonics switching system. In the area of real-time signal processing, an integrated-optics frequency-spectrum analyzer with a frequency bandwidth of over 100MHz has been developed domestically. Experimental research on optical computing and optical nonlinearity is also underway.

Domestic Development of Fiber-Optic Sensors

91P60113F Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
20 Jan 91 p 3

[Article by Liao Yanbiao [1675 1693 1753], Professor, Qinghua University, Department of Electrical Engineering: "Fiber-Optic Sensors and Trends in Their Development"]

[Summary] Domestic research on fiber-optic sensors for measurement of current, voltage, weak magnetic fields, temperature, displacement, rotation, liquid level, and other things has been underway since the late seventies at research institutes and universities nationwide. High-temperature sensors (500°C-2000°C) in both contact and non-contact types have been developed; the former have high accuracy (0.05-0.1 percent), fast response (1ms), and high spatial resolution (about 1mm), and the latter have a lower accuracy (about 1 percent) and slower response (about 1s). Numerous varieties of normal-temperature (from room temperature up to 200°C) fiber-optic sensors, including GaAs-based models, have also been developed. In the area of electromagnetic sensors, several types for measuring large currents, voltage, and weak magnetic fields have been developed and some have been commercialized; current-measurement range is 100-100,000 amps with an error of 0.5-1.0 percent, magnetic-field sensing range is down to 10^{-7} gauss at normal temperatures, and voltage-measurement range is 10V-40KV with an error of 2 percent. In the area of mechanical-measurement sensors, domestic researchers have developed fiber-optic displacement and pressure sensors utilizing transmitted or reflected intensity modulation or frequency modulation, oil-tank oil-level sensors utilizing intensity modulation or polarization-state modulation, and an experimental prototype all-fiber-optic gyro using a Sagnac fiber-optic interferometer for rotation measurement; some of these have been field-tested. In the area of flow-volume and flow-velocity measurement, solid-particle velocity sensors and gas/solid and liquid/solid biphasic interface flow sensors were among the earliest fiber-optic sensors developed domestically; a fiber-optic sensor for dust concentration has recently been reported. In addition, Chinese research on fiber-optic ring cavity interferometers and fiber-optic Fabry-Perot interferometers is at the worldwide state-of-the-art.

Optical Thin Films Resistant to High-Power Laser Damage Developed

91P60113G Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
25 Jan 91 p 3

[Article by Li Qiongrui [2621 8825 3843] and Hong Zhang [7703 4545]: "MMEI's Institute 11 Develops Optical Thin Films Resistant to High-Power Laser Damage"]

[Summary] MMEI's Research Institute 11 recently developed two varieties of optical thin films—the type GZT-9 high-average-power-laser antireflective coating and the type GJF-1 laser reflective coating—that are highly resistant to damage from high-power lasers. Testing has demonstrated that when laser light with an average power density of 1000W/cm² and a PRF of 20 per second was irradiated 3 million times (i.e., 3 million pulses) on components coated with the films, the film layer did not show the slightest damage. The excess reflectivity of the 1.06-micron-operating-wavelength

high-average-power antireflective coating is less than 0.1 percent, and the reflectivity of the high-reflectivity coating is 99.5 percent. These two films are designed to hold up under 3-million-repetition radiation pulses from lasers with an average power density of 1000-1500W/cm² and from monopulse lasers with an energy density of 160Joules/cm². Both films formally passed appraisal on 10 January [1991] at an S&T achievement accreditation conference.

First Application of Fiber-Optic Sensors to High-Voltage Measurement

91P60113H Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
25 Jan 91 p 3

[Article by Ren Guangquan [0117 0342 3123]: "MMEI's Institute 26, Chongqing University Jointly Develop

Fiber-Optic Sensing Technology Applied for First Time to High-Voltage-Measurement Engineering"]

[Summary] The GJC-1 fiber-optic-sensing insulator-type series voltage-distribution tester jointly developed by MMEI's Research Institute 26 and Chongqing University is the first such fiber-optic measurement instrument worldwide to be applied to high-voltage-measurement engineering. The new device, which integrates Pockels-effect optical technology with fiber-optic sensor technology and signal-processing technology, consists of four parts: an electrode, a sensor, fiber-optic cable, and a signal detection system. Including a 5-m-long fiber-optic cable, the entire unit weighs only 1110 grams [i.e., 1.110 kg]. Also involved in the field-testing and debugging process were the Shiyan Municipal Power Bureau in Hubei Province, the Zunyi Municipal Power Bureau in Guizhou Province, and the Ministry of Energy Resources' Wuhan High-Voltage Research Institute.

New-Generation HEMT Developed

91P60111C Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
11 Jan 91 p 3

[Article by Zheng Zhaosen [6774 0340 2773]: "New-Generation High Electron Mobility Transistor Debuts"]

[Summary] The nation's first new-generation transistor—an InGaAs high electron mobility transistor (HEMT), developed jointly by MMEI's Research Institute 13 and the CAS Institute of Physics in a project commencing in April 1989—passed expert evaluation on 22 December 1990 at the 22nd S&T Achievement Accreditation Conference. This high-frequency, high-speed, low-noise IC transistor has applications in satellite communications, radar, and electronic countermeasures technology. The total process included the Physics Institute's fabrication of the AlGaAs/InGaAs/GaAs molecular beam epitaxy material. Institute 13 was responsible for the atomic-level-thick thin films prepared via chemical etching and the metallization system for fabrication of the Schottky barrier gate, source and drain ohmic contacts, as well as for overall device design and fabrication process design. The low-noise device, whose development was formally announced [to the scientific community] in November 1990, has a noise figure of 0.87dB at 12GHz and a corresponding gain of 8.5dB—values indicating that this device meets late-eighties international standards.

Series of 16-Bit Microcomputer Processors Accredited

91P60111A Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese 9 Jan 91
p 1

[Article by Jie Yannan [6043 3601 0809]: "Series of 16-Bit Microcomputer Circuits Pass Appraisal"]

[Summary] The 80C86 series of 16-bit microcomputer processors [i.e., microprocessors]—as well as the accompanying interface circuit testing technology—developed by MMEI's Institute 47 have passed technical appraisal. This series includes the 82C82, 82C83, and 13 other (total 15) IC varieties. These circuits have the largest master drawings and highest integration and fabrication requirements among domestically produced ICs.

Breakthrough in RISC Chip-Fabrication Technology

91P60111G Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
27 Jan 91 p 3

[Article by Xiao Qiang [5135 1730]: "Breakthrough Advances in Domestic RISC Technology Research, Applications"] [Summary] The "RISC Technology Research and Applications Project" undertaken by Fudan University Associate Professor Hong Zhiliang has

resulted in a breakthrough advance for domestic manufacture of high-grade computer workstations: using 2-micron CMOS dual-layer-Al-wiring RISC standard elements, Professor Hong over a 2-year period designed a 32-bit RISC-chip logic diagram compatible with the SPARC [scalable processor architecture]-structure instruction set. This SPARC-chip logic diagram will be implemented in chips to be put into batch production during the Eighth 5-Year Plan.

New ICs Developed by Qinghua University Microelectronics Institute

91P60111F Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 23 Jan 91 p 1

[Article by Shi Jianping [4258 1696 1627]: "10 High-Level Achievements of Qinghua Microelectronics Institute"]

[Summary] Ten Seventh 5-Year Plan and 863 Program high-level S&T achievements of Qinghua University's Microelectronics Institute were formally accredited on 18 January at a ceremony sponsored by the State Education Commission and by MMEI. The technical committee, including CAS Academic Commission members, appraised the achievements as meeting late eighties international standards.

Passing appraisal were two 16-bit LSI chips—the C_μ8250 programmable asynchronous communications device and the C_μ8237 programmable DMA [direct memory access] controller—which, together with the 16-bit CPU developed earlier by the university, form a complete LSI chip set for domestically made 16-bit high-speed microcomputers; the CFBP3 bandpass-filter ASIC, oriented towards defense electronics needs; the THT2559F dual-audio frequency telephone-dialing IC; four IC computer-aided-engineering projects; "GaAs/Si Optoelectronics IC technology," including an LED with luminous efficiency of 50 mA per 4mW [consumed power], exceeding the world record heretofore reported in documents, and a quantum-well LED, a novel device proposed and developed for the first time worldwide; and basic research projects in SOT [expansion not given], three-dimensional ICs, and radiation-hardened circuitry.

13 Types of ASICs Pass Appraisal

91P60111E Beijing JISUANJI SHIJE [CHINA COMPUTERWORLD] in Chinese No 3, 16 Jan 91 p 1

[Article by Liu Keli [0491 0344 7787]: "13 Kinds of ASICs Pass Appraisal"; cf. 91P60111B, above]

[Summary] Passing formal technical appraisal on 28 December 1990 were eight types of ASICs developed by the Beijing Integrated-Circuit Design Center for Winchester disk drives (WDD), the VENUS semi-custom digital circuit automatic design system, an 8-bit single-board-computer output interface special-purpose drive-control-system ASIC, a counter alarm circuit, a cell-type

digital controller, and ASICs for DS2 and DS3 fiber-optic communications systems. The eight WDD ASICs include the BIC8737 digital interface LSI chip for 3.5-inch 2OMB and 5.25-inch 4OMB drives, an LSI analog hybrid read/write ASIC, an LSI digital/analog hybrid reset ASIC, and an MSI [medium-scale-integration] linear IC.

GaAs VHSICs, Other ICs Developed by Institute 13

91P60111D Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese
16 Jan 91 p 1

[Article by Shi Xuan [4258 1357]: "Research Institute 13 Completes Key Seventh 5-Year Plan Tasks"]

[Summary] Seventh 5-Year Plan projects completed by MMEI's Research Institute 13 include 11 Key State S&T projects and five State 863 Program high-tech projects. At the recently concluded 22nd S&T Achievement Accreditation Conference, the following Institute 13 projects passed formal appraisal: GaAs very-high-speed integrated circuits (VHSICs), including 5GHz dynamic and 3GHz static frequency dividers, and 208-gate and 30-gate gate-array circuits; 2-inch GaAs [wafer] fabrication technology; an InGaAs heterojunction HEMT and associated integrated circuitry; a heterojunction bipolar transistor with a maximum frequency of oscillation exceeding 14GHz, and associated integrated circuitry; and a CAD software package for design of GaAs microwave circuits and VHSICs. These projects will provide a major boost to the development of the domestic microelectronics industry in the Eighth 5-Year Plan.

10 New ASICs Pass Appraisal

91P60111B Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese
11 Jan 91 p 1

[Article by Liu Keli [0491 0344 7787] and Lian Jiangzhou [6647 3068 3166]: "Ten Kinds of ASICs Debut"]

[Summary] Ten varieties of application-specific integrated circuits (ASICs) developed by Beijing Integrated-Circuit Design Center passed appraisal on 28 December 1990 in Beijing. These circuits are useful in the electronics industry and particularly so in the computer industry; Great Wall Computer Co., for example, is a major user. Of the 10 ASICs now accredited, eight are for computer peripheral Winchester disk drives and some of these ASICs are already in batch production. Also passing appraisal were a cell-type digital controller and ASICs for DS2 [8Mb/s, 120 voice circuits] and DS3 [34Mb/s, 480 voice circuits] fiber-optic communications systems; these ASICs are of a quality matching that of foreign-made 2-micron CMOS double-wiring products.

Study of Recombination Centre Levels In N-Type LPE GaAs Layers Irradiated by Electrons

40100031A Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese
Vol 11 No 12, Dec 90 pp 889-895

[English abstract of article by Hu Yusheng, Wang Le and Chen Zhengxiu (Shanghai Institute of Metallurgy, CAS) (MS received 24 Jan 90)]

[Text] Using deep-level transient spectroscopy, surface photovoltage and routine measurements, the defects induced by different doses of electron irradiation with 1MeV energy in N-type LPE [liquid-phase-epitaxy-grown] GaAs layers, and their isochronal annealing behavior at temperatures ranging from 400K to 550K have been systematically studied. The variations of defect density and minority carrier diffusion length are discussed as the electron radiation dose increases and after isochronal annealing. It has been proved both theoretically and experimentally for the first time that the level E_3 is the main recombination centre level in all of the defect energy levels induced by electron radiation. It is also shown that the main recombination centre level among all the defect levels can be effectively identified by using the Shockley-Read-Hall formula.

Calculation of EL2 Energy Level and Optical Cross Section of Semi-Insulating GaAs Crystal

40100031B Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese
Vol 11 No 12, Dec 90 pp 896-905

[English abstract of article by Wang Chuankui and Xu Wantang (Department of Physics, Beijing Normal University) (MS received 25 Dec 89)]

[Text] The energy level and wave function of EL2 defect model have been calculated by using the EHT. The cluster contains 41 atoms. The secular equation is reduced by using group theory. The optical cross section associated with EL2 has also been calculated. The theoretical results are in agreement with the experimental results.

Low-Dark-Current High-Gain InGaAs/Inp SAGM APD

40100031C Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese
Vol 11 No 12, Dec 90 pp 958-961

[English abstract of article by Wang Shutang, Zeng Jing, Li Feng, Hu Chunyang, Xia Caihong, Sun Jie and Fan Aixiang (Institute of Semiconductors, CAS, Beijing) (MS received 15 Jan 90)]

[Text] By optimally designing the device structure, strictly controlling the parameters of LPE growth and perfecting the fabrication process for the devices,

InGaAs/InP SAGM APDs [avalanche photodiodes with separate absorption, grading, and multiplication layers] with low dark current and a high multiplication factor have been obtained. More than 100 devices have been measured. The responsivity and the multiplication

factor of these devices are about 0.7-0.8 mA/mW and 30-85, respectively (incident light wavelength 1.3 μm , light power 1.6 μW). The dark currents participated in the avalanche multiplication process and at 0.9V_b are less than 2 nA and 20 nA, respectively.

**World Record Claimed for YBCO Thin-Film
Critical Current Density**

91P60104A Beijing KEJI RIBAO [SCIENCE AND
TECHNOLOGY DAILY] in Chinese 9 Jan 91 p 1

[Editorial Report] KEJI RIBAO of 9 Jan 91 carries on page 1 a 475-word article on major Chinese achievements in superconductivity R&D as reported at the "Superconductivity Key Strategic Goals Symposium" held in Beijing in early January 1991. Additional details not already given in earlier reports on this subject [see

FBIS-CHI-91-010, 15 Jan 91, pp 32-33; FBIS-CHI-91-020, 30 Jan 91, pp 29-30; and JPRS-CST-91-004, 5 Feb 91, p 28] are provided below.

A 92.3K-critical-temperature high-quality yttrium-barium-copper-oxide (YBCO) superconducting thin film prepared by Chinese scientists has a critical current density of 4 million amperes/cm² when measured at a temperature of 77K with no magnetic field. The highest value measured by the scientists for this superconducting thin film has reached 7 million amperes/cm², a world record.

More Developments in Fiber-Optic Communications Described

First Domestic Fiber-Optic LAN Using Chinese Components

91P60102 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 50, 26 Dec 90 p 35

[Article by Gao Yuqian [7559 3022 0051]: "Shanghai Completes First Domestic Fiber-Optic Local Area Network Using Chinese-Made Components"]

[Summary] Research and project engineering on the nation's first computer fiber-optic local area network (LAN) built with Chinese-made components—the WEN HUI BAO News Agency Building's fiber-optic LAN—recently formally passed acceptance check. The development of this project, one of the second group of State Fiber-Optic Communications Demonstration Projects as well as a Shanghai Municipality priority project, involved the cooperation of the WEN HUI BAO News Agency, Shanghai Jiaotong University's Fiber-Optic Technology Institute, the Shanghai Municipal Fiber-Optic Communications Engineering Company, and the Shanghai Cable Institute. In addition to connecting office computers within the agency's multi-storied main building, the network has a telecommunications interface for two-way information exchange between the WEN HUI BAO building and the XINHUA Agency, as well as between the WEN HUI BAO building and the WEN HUI BAO provincial bureaus.

This fiber-optic LAN, which uses 0.85-micron short-wavelength GI [graded index] multimode optical fiber, currently includes 30 workstations. Both 3+ network and Novell network operating systems will run in the LAN. The organic unification of an MIS, a computerized news-gathering and editing system, and a computerized typesetting system into this fiber-optic LAN is a major step toward realization of the "intelligent building" concept for the WEN HUI BAO News Agency.

Shanghai Becoming Major Production Center

91P60102 Shanghai JIEFANG RIBAO in Chinese 1 Jan 91 p 1

[Article by Jia Baoliang [6328 1405 5328]: "Shanghai Becoming Fiber-Optic Communications Industrial Colony"]

[Summary] New, rising fiber-optic communications businesses in Shanghai Municipality are rapidly becoming a fiber-optic communications industrial colony of their own, with an output value surpassing the 100 million yuan mark in recent years. These firms are involved in improving product quality through research into stronger, lower-loss, purer materials. Support has come from the Shanghai Municipal Government, which launched in 1988 a major campaign to fund manufacture of materials (including fiber and auxiliary products) for

and construction of 14 intramunicipal projects (i.e., fiber-optic lines) totaling 20,000 kilometers in length. From 1988 to the present, the Shanghai Xinhua [2450 3337] Glass Plant has utilized its imported manufacturing equipment to achieve an annual output of 6,000 kilometers of fiber. The first Sino-foreign optical-communications joint venture, Shanghai AT&T Co., has achieved an annual output capacity of 4,000 state-of-the-art optoelectronic terminals. Already laid within the municipality are fiber-optic lines (built from both imported and domestically made fiber) totaling 270 kilometers for the municipal network and over 30 kilometers for the outlying-areas network.

Unrepeated Undersea System Operational

91P60102 Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 2 Jan 91 p 1

[Article by Li Yupei [2621 3768 1014]: "Unrepeated Undersea Fiber-Optic Cable Communications System Operational"; see earlier report in JPRS-CST-91-004, 5 Feb 91 p 30]

[Summary] An unrepeated undersea fiber-optic cable communications system was successfully put into service on 27 November 1990. This 32-kilometer-long system, which uses 4-fiber single-mode optical cable, has a transmission rate of 8448 kb/s [8.448Mb/s, the DS2 standard] and a maximum capacity of 120 voice circuits for telephone conversations or for data or FAX transmissions. Optical terminals for this digital fiber-optic system were jointly developed by Qinghua University and Plant 730, optical terminals and electronic terminals were manufactured by Plant 730, and fiber-optic cable was jointly developed and provided by MMEI's Institute 8 and the Hongqi Cable Plant.

14 Achievements Accredited

91P60102 Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 4 Jan 91 p 1

[Article by Li Guoyi [2621 0948 4135]: "14 Achievements in Fiber-Optic Communications Pass Appraisal"]

[Summary] Fourteen Seventh 5-Year Plan key state projects, MPT priority projects and other priority projects in fiber-optic communications assigned to the Wuhan Institute of Posts & Telecommunications Science recently passed ministry-level appraisal. The four Seventh 5-Year Plan projects now accredited include development of a long-wavelength 1.3-micron single-mode optical fiber, a long-wavelength zero-dispersion 1.55-micron single-mode optical fiber, a single-mode optical fiber attenuation tester, and an uncooled 1.55-micron long-life laser diode array. A State 863 High-Tech Program project now accredited involves R&D of a 1.55-micron distributed-feedback laser diode. A State Planning Commission priority project now accredited consists of extension tests for multimode graded-index optical fiber and industrial tests for single-mode optical

fiber. Finally, eight MPT priority projects now accredited include development of microwave smelting equipment and rod-making technology as well as a series of VLSI circuits for digital multiplexing equipment and other devices.

The 60 technical experts assembled from across the nation for the formal appraisal unanimously concluded that the majority of projects are at a mid-to-late-eighties international level and that a minority approach the worldwide state-of-the-art.

Focus on Shanghai Engineering Company

91P60102 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 5 Jan 91 p 2

[Article by Yue Ziqiang [2867 1311 1730]: "Shanghai Fiber-Optic Communications Engineering Company Becoming Crack Force in Industry"]

[Summary] The Shanghai Fiber-Optic Communications Engineering Company (SFCEC), formed from 20 member units including Shanghai Jiaotong University and the Shanghai Cable Institute, has in a 5-year period completed over 45 projects with a gross output value of 47 million yuan in areas such as public communications, image transmission, electric power control, and computer LANs. Recently, this vertically and horizontally integrated organization was designated by the State Council's Office for Promotion & Application of Electronic Information Systems (OPAEIS) as a key national fiber-optic communications engineering design and construction unit.

Including in its makeup not only institutions of higher learning and ministry-run research institutes but also industrial enterprises, SFCEC has affiliated via the group board of directors method to synergistically create an research/engineering design and construction/new-product development entity. One of its completed projects is a 23-kilometer-long single-mode long-wavelength DS4 [140Mb/s, 1920 voice circuits] fiber-optic communications system for the Shanghai Municipal Telephone Network; this project was built in only 3 years with the assistance of the CAS Shanghai Institute of Optics & Fine Mechanics. With the aid of Shanghai Jiaotong University, SFCEC developed and built 23 compact, high-performance, low-cost PFM [pulse-frequency modulation] miniature image optical terminals. The Shanghai Municipal Public Security Bureau's 7.5-square-kilometer [highway] traffic monitoring & control system, the Shanghai Municipal Telephone Office's aforementioned system, and three other fiber-optic communications systems built by SFCEC have been singled out by the State Council's OPAEIS as national pilot demonstration projects.

24-Fiber Optical Cable Developed

91P60102 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 5 Jan 91 p 2

[Article by Wang Kejian [3769 0344 0313]: "24-Core Fiber-Optic Cable Developed at Houma Cable Plant"]

[Summary] The 24-fiber optical cable developed by MPT's Houma Cable Plant recently passed technical appraisal. This low-cost, lightweight, skeleton-type fiber-optic communications trunkline cable, one of the Key State New Products developed in 1990, has the largest capacity of any domestic optical cable, low attenuation, a large usable temperature range, and can be easily laid in a variety of adverse conditions. The experts at the formal appraisal commented that its structural, optoelectronic, mechanical, and physical properties and performance all meet or exceed national standards.

National Statistics Released

91P60107A Beijing DIANXIN JISHU [TELECOMMUNICATIONS TECHNOLOGY] in Chinese No 1, Jan 91 p 46

[Unsigned article: "Nation's Fiber-Optic Communications Industry Rapidly Developing"]

[Summary] It has been learned from the MPT-sponsored Fiber-Optic Communications Information Network Conference held in August 1990 in Hohhot that the recent development in the domestic fiber-optic communications industry has been quite rapid: through the end of 1989, 6545 km of fiber-optic cable had been laid on the mainland, with an additional 11,470 km of optical cable planned for laying or being laid, among which 61 percent was imported and 39 percent domestically made; 70 percent of the optical cable has gone for public networks. The fastest operational domestically made systems are 140Mb/s [DS4, 1920 voice circuits]; 565Mb/s [DS5, 7680 voice circuits] systems are currently being developed and could be put into operation soon. Lines with 1.55 μ m wavelength fiber are in an experimental stage; repeater range can exceed 50 km. Domestically made distributed-feedback laser diodes and long-wavelength avalanche photodiodes could be deployed before year's end, and coherent optical communications systems and fiber-optic amplifier technology are being developed domestically.

Fiber-Optic Line for Xinjiang Province

91P60107B Beijing DIANXIN JISHU [TELECOMMUNICATIONS TECHNOLOGY] in Chinese No 1, Jan 91 pp 46-47

[Unsigned news brief: "Short Waves from the Provinces"]

[Summary] A fiber-optic-cable communications project linking Urumqi to Turpan—one of the key Seventh 5-Year Plan projects for the Xinjiang Province Bureau of

Posts & Telecommunications, as well as the first fiber-optic-cable line for the autonomous region—passed acceptance check on 10 September 1990. This 186-km-long line, which uses 8-fiber optical cable, will have a first-phase capacity of 600 voice circuits and a final-phase capacity that can reach 5700 circuits. The system employs optoelectronic equipment made by MPT's Wuhan Institute of Posts & Telecommunications Science and MPT's Houma Cable Plant, has four repeater stations (including three unattended stations), and 96 junction points with a total of 768 splices. Average single-splice attenuation is 0.057dB. Construction time for the entire project was short (only 1 year), and trial operation went smoothly, with all design requirements fulfilled.

Local Relay Line for Shantou City

91P60107C Beijing *DIANXIN JISHU*
[TELECOMMUNICATIONS TECHNOLOGY]
in Chinese No 1, Jan 91 p 47

[News brief by Yang Miaosheng [2799 8693 3932] and Xu Weiguang [6079 0251 0342]: "Short Waves from the Provinces"]

[Summary] The Posts & Telecommunications Bureau of Shantou City [in Guangdong Province] has imported

NE6000 fiber-optic equipment from Japan's NEC for use in an inter-bureau relay line. This digital fiber-optic transmission system will add 1920 voice circuits that will alleviate the crowded conditions in the present inter-bureau relay line.

New Domestically Made Optoelectronic Terminals

91P60107D Beijing *DIANXIN JISHU*
[TELECOMMUNICATIONS TECHNOLOGY]
in Chinese No 1, Jan 91 p 47

[Unsigned news brief: "Short Waves from the Provinces"]

[Summary] MPT's Wuhan Institute of Posts & Telecommunications Science has developed a new type of optoelectronic terminal employing the WG series of fiber-optic communications application-specific large-scale integrated circuits [ASICs]. Compared to existing domestically made terminals, these new terminals are two-thirds smaller in volume, dissipate half the power, are half the cost, and have greatly improved reliability. This development is a major step forward toward the realization of Chinese-made high-quality, high-reliability miniaturized terminals.

Shape Measurement of Synchrotron Radiation With High Time Resolution

91FE0055A Beijing GAONENG WULI YU HE WULI [HIGH-ENERGY PHYSICS AND NUCLEAR PHYSICS] in Chinese Vol 14 No 8, Aug 90 pp 677-683 [MS received 17 Oct 89]

[Article by Cao Zhong [2580 1813], Liu Weiren [0419 1983 0088], Wang Lilie [3769 0500 0441], Xie Shiliang [6200 0013 0081], Jiang Liping [3068 0500 1627], and Ding Meisong [0002 2734 2646] of China Institute of Atomic Energy, Zhao Jilai [6392 4480 0171], Ren Youlai [0117 0645 0171], and Shan Bing [1472 0393] of Xian Institute of Optics and Precision Mechanics of the Chinese Academy of Sciences, and Zhao Zheng [6392 2973] and Cui Mingqi [1508 2494 0796] of the Institute of High Energy Physics of the Chinese Academy of Sciences: "Shape Measurement of Synchrotron Radiation With High Time Resolution"]

[Text] Abstract: A Chinese-made BWS-5KII picosecond streak camera was used to measure the time structure of synchrotron radiation (SR) produced by extremely relativistic electron and positron bunches on the BEPC (Beijing Electron Positron Collider) and the dependence of SR light pulse width upon beam current and RF voltage was also determined. When electron beam increased from 2 mA to 30 mA, the pulse width went from 220 ps to 670 ps. At 20 mA electron beam current, the pulse width varied between 500 ps and 700 ps as the RF voltage increased from 250 kV to 500 kV. The time resolution of the measurement system is 30 ps and the uncertainty is ± 15 percent. The trigger jitter is less than ± 200 ps.

I. Introduction

In a high energy electron storage ring, due to the presence of the deflecting magnetic field, extremely relativistic electrons are subject to centrifugal acceleration and simultaneously emit a very intense radiation—synchrotron radiation. This is a novel high brightness radiation source with a wide range of future applications. It spans across infrared to X-ray. Furthermore, it is the brightest continuous radiation source in vacuum ultraviolet and X-ray. Its angle of emission is $1/\gamma$ (the spontaneous emission angle is only 0.00025 rad for 2 GeV electron). Therefore, it collimates well. Its pulse width is a few hundred picoseconds and is a very useful tool in studying dynamic processes. In the measurement of fluorescent lifetime and time-resolved absorption and emission of materials, SR is already being widely used. SR has become an important high-tech analytical tool in fundamental and applied microelectronics, physics, chemistry, biology, and medicine. Presently, BEPC has been constructed and is in operation. It offers us bright prospects not only in research on high energy physics and fundamental particles but also in applications of synchrotron radiation. On one hand, in order to develop this precious resource, it is necessary to know the width and time structure of SR to perform various time resolution experiments. On the other hand, because the time structure of SR is directly related to the length and

charge distribution of the high energy electron bunch, the dependence of the dynamic behavior of electron bunches in the storage ring upon other operating parameters of the accelerator (such as energy, beam current and RF voltage) can be determined by measuring its time structure. This provides experimental data for the design and testing of the accelerator. Therefore, it is also an important diagnostic tool for the beam. However, because SR pulse width is only a few hundred picoseconds, it is necessary to have a very high time resolution technique (better than tens of picoseconds).¹ A BWS-5KII streak camera developed by Xian Institute of Optics and Precision Mechanics was used to measure the width of visible SR from BEPC. Moreover, the dynamic behavior of this camera was evaluated. The results are given in this paper.

II. Experimental Principle and Apparatus

2.1 Brief Introduction of the ps Streak Camera

A ps streak camera is a time measuring tool of the highest time resolution (commercial product with similar to 2 ps resolution is available). It is widely used in the measurement of a variety of transient processes, such as the development of short pulse laser, laser fusion, plasma diagnosis, intense short electron pulse diagnosis and fluorescent decay lifetime. It consists of an incident optical system, ps streak image tube, image enhancer, SIT picture tube, electrical scanning and control, contact camera and data readout system. Its operating principle is as follows.

Figure 1 is a schematic diagram of the core of a ps streak camera, including a ps streak image converter tube and an optical imaging system. When a series of narrow visible light pulses (e.g., 100 ps wide, 1 ns apart) is shining on a horizontal slit S (30-50 μ m wide and 15 mm long), an image of the slit is formed by the image converter tube on the cathode K of the highly sensitive ($> 100 \mu$ A/l m) grid. Due to photoelectric effect, the cathode emits photoelectrons. The pulse width of photoelectron is directly determined by the width of the light pulse. The voltage between the anode and cathode is 11,000 volts. In the presence of this electric field, the photoelectron is flying toward the anode A after passing through the accelerating electrode Acc. There is a streak deflection plate D in the middle. Ordinarily, there is a bias on it so that the electron hits other parts of the tube, instead of the anode. However, when a light trigger signal (similar to 20 ns) is applied to the streak circuit earlier, a fast high voltage slope is applied to the streak deflector D. The electric field on the deflector is perpendicular to the slit. Its polarity partially cancels the static bias to allow photoelectrons to go through the deflector to reach the anode. Because the leading edge of the streak voltage has a linear slope, photoelectrons passing through the deflector will fall on different part of the fluorescent screen due to different electric field strength to form a "fringe" image. This realizes a time-space transformation, converting difference in time to spatial distribution vertical to the slit on the fluorescent screen. Let us

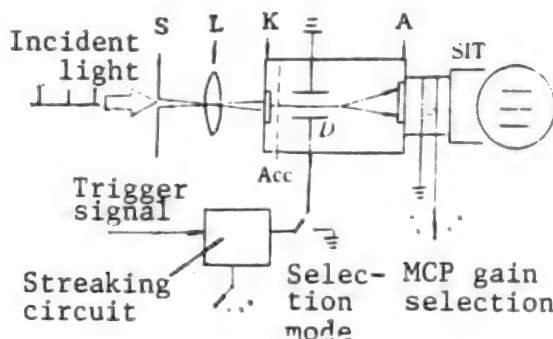


Figure 1. Principle of Streak Camera

assume that the sensitivity of the deflector is 45 mm/kV and the voltage slope is 1.5 kV/ns, then 100 ps in time will result in a 6.7 mm wide, 15 mm long (i.e., length of the slit itself) image. If the effective dimension of the fluorescent screen is 40 mm, then a full screen is approximately 600 ps. In a 512 x 512 channel data acquisition system each channel corresponds to 600 ps/512 = 1.2 ps.

In order to improve the sensitivity of the camera, weak light on the fluorescent screen is amplified. A MCP image enhancer and SIT silicon image tube can provide gains of 5,000 and 9,000, respectively. The coupling between devices is done with fiber-optic end plates to minimize light loss in the transfer process. There are two ways to gather the data. One is to use a contact camera to take a picture of the image enhancer screen, taking full advantage of the light signal on the fluorescent screen. We employed another method. A microcomputer was used for data acquisition. The conversion of graphic signal was done using an industrial TV camera. The scanning system in the picture tube converts the optical picture into video signals. On one hand, these video signals are sent to a monitor to be restored into a picture. In addition, they are also stored in the computer for further processing and analysis. This is a simple and powerful method. For instance, the BWS-5KII camera has a 512 x 512 two-dimensional picture display and analysis system.

2.2 Introduction of Experimental Optical Path

The SR optical path was described in detail in reference 2. A channel comprised of mirrors leads visible light to a

weak light measuring apparatus in the optical laboratory. The beam is focused on the slit of the ps camera by a lens to raise the optical energy density. Other optical parameters are as follows. When BEPC is operating at 2.8 GeV and the average current is 66 mA, the center visible light wavelength is 650 nm and the field angle is 2.466 mrad. The time span caused by this finite field angle is 84 ps ($2.466 \times 10^{-3} \times 1034 \text{ cm} \times 33 \text{ ps/cm}$, where 1034 cm is the radius of the electron orbit). The field angle for visible light between 400-800 nm is 2.1-2.64 mrad. Each beam irradiates 0.17 W/rad of visible light per unit field angle.

2.3 Electronic Circuit

Figure 2 shows a schematic diagram of the experimental apparatus. The prism splits the SR beam (cross-section 1 mm x 5 mm) into beam I and II. Beam I is focused at the slit of the streak camera by a 50 mm lens to raise the light intensity. This arrangement can improve both the light utilization rate and the sensitivity of measurement. Beam II is a trigger signal for streaking. This beam is received by a fast photomultiplier such as the XP2020 or the MCP type R1645U photomultiplier by Hamamatsu. The output signal from the photomultiplier is amplified by a fast amplifier (ORTEC 579) and then made into a single sweep. Every time the camera is turned on, the streaking ramp circuit only operates once to protect the high voltage avalanche tube in the circuit. Since the electron beam bunch frequency in the BEPC storage ring is 1.247 MHz, the avalanche device can easily be damaged at such high frequency without a single sweep process. This single sweep circuit consists of a single pulse generator and a fast linear gate. The single pulse generator generates a 780 ns wide gate pulse with a 2 ns leading and trailing edge when the button is pushed. This pulse opens the fast linear gate to allow the signal from the amplifier to go through. Because the interval of this series of pulses is 801.9 ns (which is the interval of SR), only one pulse can pass through. This pulse then goes through a 150 m long coaxial high frequency cable (SWY-50-5-1) and finally reaches the input of an ORTEC 583 constant ratio discriminator. The constant ratio discriminator can minimize trigger jitter due to light pulse amplitude instability. It triggers the synchronizer to generate a 16 V, 25 ns positive

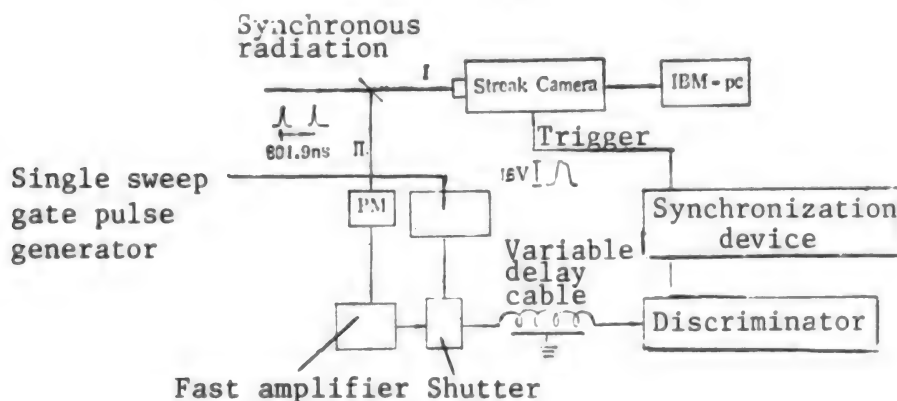


Figure 2. Block Diagram of Experimental Apparatus

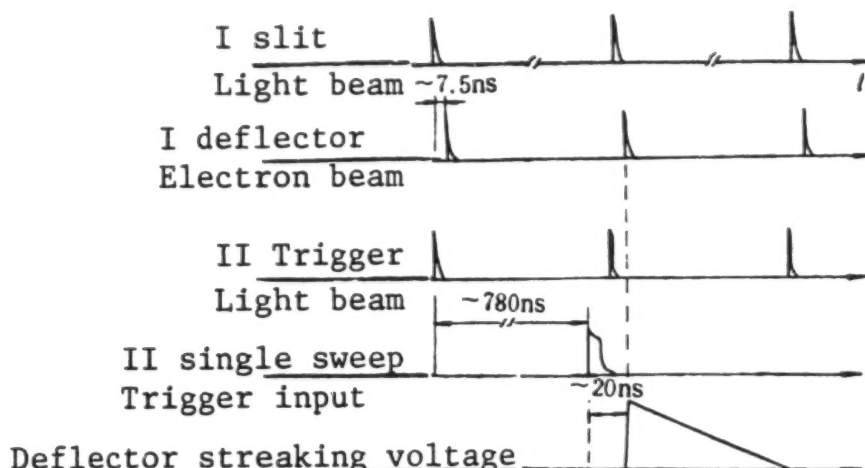


Figure 3. Time Relation Between Two Signals

trigger signal with a rise time of under 1 ns which is sent to the trigger input of the streak camera.

Trigger synchronization is very critical. Because the trigger signal must precede the measured signal by some time (20-35 ns depending on the streak rate), the periodicity of SR is utilized by properly delaying the last light signal (for approximately 780 ns) to trigger the camera to observe the wave form of the next light beam. Figure 3 shows the time relation between them. SR is split into beams I and II by the prism. The electric signal caused by beam II is delayed by 780 ns before triggering the camera. The delay can be adjusted with an accuracy of 250 ps. By properly adjusting the delay, it is possible to have the leading edge of the high voltage ramp applied to the deflector as the measured signal passes through it to achieve synchronization.

2.4 Effect of Long Delay on Time Jitter

In our experimental apparatus, 150 m of high frequency coaxial cable was used. After going through such a long delay in the cable, the high frequency component of the trigger signal decayed significantly. In addition, it is also susceptible to factors such as electromagnetic interference and temperature effect which might result in relatively large time jitter. To this end, the time jitter in the delay trigger system described above was experimentally measured. Figure 4 shows the measuring circuit diagram. The mercury switch generates a 0.70 V, 25 ns wide narrow pulse with 1 ns rise time at a frequency of 100 Hz. After passing through the ORTEC 583 constant ratio discriminator, it is split into two. One goes directly to the ORTEC 457 time-amplitude converter as a "start" signal and the other goes through 135 m of high frequency coaxial cable and a variable delay line before reaching the input of an ORTEC 583 discriminator. The discriminated output serves as the "stop" signal for the ORTEC 457 converter. The output of the time-amplitude converter is sent to a multi-channel amplitude analyzer. The span of the time-amplitude converter was set at 1 μ s. The characteristic time resolution of the above system was measured to be 50 ps. The effect of long delay on the time

jitter of the system can be determined from the half width of the time spectrum. It was found that when the time spectrum effect could be neglected (close to characteristic resolution of 50 ps) when the delay is less than 700 ns. When the total delay from the long cable and variable delay line is greater than 700 ns, the time spectrum gradually expands. However, even with a total delay of 914 ns, the time jitter is less than 87 ps (i.e., square root of $100^2 - 50^2$). Compared to the trigger jitter of the camera itself (± 200 ps), it is small. Therefore, it would not have a significant impact on the capture probability of measurement. This point was also verified in later accelerator experiments (trigger jitter less than ± 200 ps).

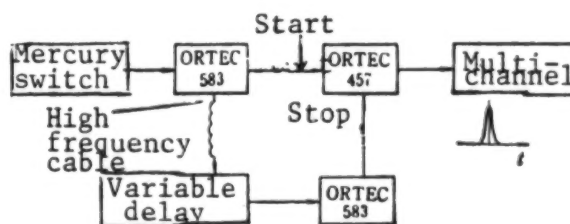


Figure 4. Block Diagram of Time Jitter Measurement

III. Experimental Results and Analysis

3.1 Camera Performance

First, the dynamic behavior of the 30 ps BWS-5KII streak camera was thoroughly evaluated using the BEPC synchrotron radiation in order to ensure its reliability. The results are as follows.

(1) The dynamic sensitivity of the camera is better than 2×10^{-12} J. This was estimated as follows. When electron energy is 1.6 GeV and current is 66 mA, the visible light energy generated by each electron beam bunch at the point of radiation is 2×10^{-10} J. Considering transmission losses, the optical energy reaching the slit of the camera is approximately 5×10^{-11} J. The background

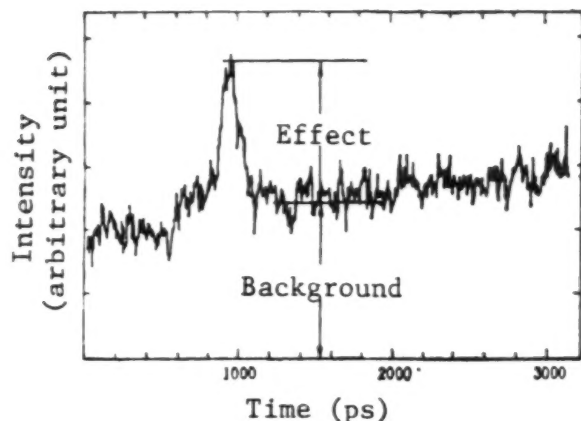


Figure 5. SR Time Spectrum ($I = 1$ mA, $E = 1.549$ GeV, FWHM = 190 ± 30 ps)

fringe image ratio at a mean current of 2 mA was measured to be 1.5. This corresponds to an optical energy of approximately 1.5×10^{-12} J on the slit. Taking into account the uncertainty of the light transmission loss estimate, we reached the conclusion that the sensitivity of the camera is better than 2×10^{-12} J.

The effective background ratio of the BWS-5KII camera was significantly improved with the addition of the MCP image enhancer and Millisecond shutter control. It minimizes background and raises sensitivity of measurement. It was experimentally found that the signal to noise ratio could be raised by a factor of four with gate control under a weak light condition that the signal background ratio was close to 1. This improvement put the dynamic sensitivity of the camera to above 10^{-12} J. Figure 5 is a time-intensity curve obtained at a mean current of 1 mA. Without gating, the effect is completely buried.

(2) Trigger Jitter. There is some uncertainty associated with the position of the fringe image on the fluorescent screen at high scanning speeds. When the optical pulse amplitude varies less than 10 percent, the trigger jitter of the measurement system is below ± 200 ps. Over more than 40 hours of cumulative operation, the camera was working steadily. The capture rate in the third gear (3,500 ps full scale) is close to 100 percent.

By properly varying the trigger delay, the position change of the image on the screen is measured to directly determine the streaking speed in the third gear and its full scale. Specifically, under the condition that the SR intensity is strong and stable (e.g., $E = 2.2$ GeV, $I = 15$ mA), pictures of the image are taken many times (i.e., 23) with a certain length of delay line (so that the image is on the right side of the screen) in order to obtain a time-intensity curve. The mean position of the leading edge half height point P_1 becomes available. Then, the delay is lengthened by 1 ns so that the image on the fluorescent is shifted toward the left. The same procedure is repeated to obtain the new leading edge half maximum point

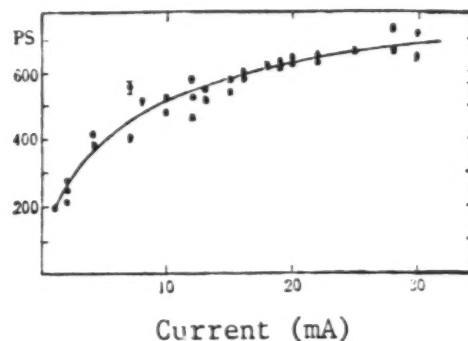


Figure 6. FWHM of SR at Different Electron Beam Currents

position P_2 . The channel width is $1 \text{ ns}/(P_1 - P_2)$. Further, it is possible to derive the full screen scale (i.e., 512 x channel width) and streaking speed (i.e., screen length/full screen scale). The streaking speed, full screen scale and channel width were experimentally found to be 11.4 mm/ns, 3.5 ns and 6.84 ps/channel, respectively. The error of determination is ± 15 percent, which is consistent with that obtained with a narrow mode-locked laser with F-P standard. It was also experimentally found that the bias applied to the deflector has a significant impact on the streaking speed and full screen scale. Different bias might cause full screen scale to vary between 2.5-4.5 ns. Therefore, once the streaking speeds for different gears are determined, the bias must remain constant.

3.2 Measurement of Synchronous Radiation Pulses

Figure 6 shows the pattern how the FWHM (full width half maximum) of SR pulse varies with electron beam current in the storage ring. The electron beam energy is 1.549 GeV. The curve is the least square fit of experimental points ($\text{FWHM} = 5.35 \times 10^{3.723}$). From the figure, when the beam current rises from 2 mA to 30 mA, the pulse width increases from approximately 220 ps to 670 ps. When the beam current is 20 mA, varying the RF voltage within 250-500 keV would cause the pulse width to vary between 500-700 ps. The SR produced by positron at 2.10 mA was also measured. Its width is similar to that of electron.

Figures 7 and 8 [not reproduced] are streak images of 1.549 GeV electron taken at 10 and 12.5 mA, the windows chosen for computer data processing and the light pulse intensity versus time curves derived from the data analysis. Figures 9 and 10 are the time spectra printed by the computer. The condition of measurement is 1.549 GeV electron at the same current (i.e., 10 mA).

An analysis of these figures shows that shapes of SR pulses vary quite a bit. Some are Gaussian (Figure 8) and some deviate from Gaussian (Figures 7, 9, and 10). The shape varies quite rapidly. For example, Figures 9 and 10 were measured one minute apart and their shapes are quite different. Reference 3 reported the presence of fine

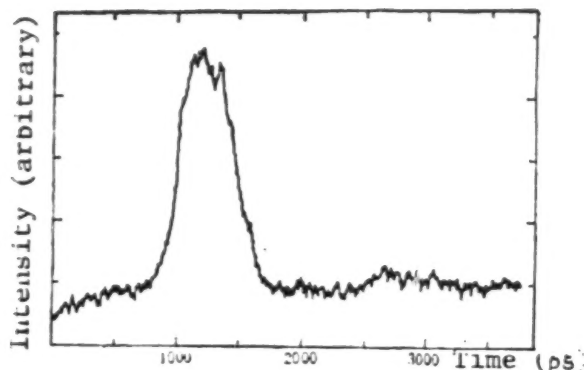


Figure 9. Time Spectrum of Synchrotron Radiation (10 mA, 1.549 GeV, FWHM = (500 ± 30) ps)

structure inside an electron beam bunch. Therefore, it is necessary and significant to study the cause of this shape change. Next, the pulse width of SR fluctuates a lot (see Figure 6). When the electron energy in the storage ring is 2.2 GeV and at an electron beam current of 15 mA, the width was found to vary by ± 15 percent as a result of seven measurements.

Since the SR pulse shape directly reflects the charge distribution of the relativistic electron beam bunch in the storage ring, its FWHM is directly dependent upon the length of the electron beam bunch. Therefore, the fluctuation in pulse width and the fine time structure measured in this work might reflect the dynamic characteristics of the relativistic electron beam bunch in the BEPC storage ring. They might be due to fluctuation of electron beam bunch length and presence of fine structure.^{1,3} It was observed in the experiment that after the SR pulse width suddenly widened, the electron beam bunch just abruptly disappeared. This indicates the presence of longitudinal instability of the electron beam bunch.

In order to derive the distribution of the electron beam bunch based on the light pulse shape, it was necessary to make a correction for the distortion caused by the 7 m optical path. The emphasis of this work is to verify the feasibility of using a domestically made streak camera in subnanosecond and picosecond diagnosis of RF accelerator. Due to time limitation, it was not possible to systematically measure issues related to electron beam bunch kinetics, such as the relation between bunch

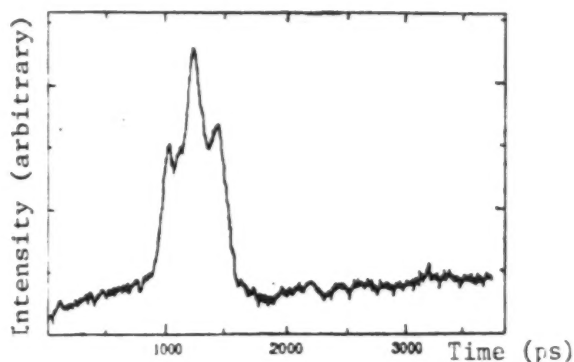


Figure 10. Time Spectrum of Synchrotron Radiation (10 mA, 1.549 GeV, FWHM = (520 ± 30) ps)

length and RF voltage, longitudinal instability of beam bunch and fine structure. Nevertheless, from this preliminary study we can see that an ultrahigh time resolution streak camera is a powerful tool to study the fine time structure of SR and the dynamic behavior of electron beam bunch in the storage ring. It plays a significant role in improving the quality of operation of the accelerator and the beam current. In the future, we intend to work more closely with accelerator researchers to dig deeper into this area.

The authors wish to express their gratitude to Research Fellow Ding Dazhao [0002 1129 6856], Xian Dingchang [0405 7844 2490], and Liu Shiyue [0491 0013 6460] for their concern and support, to Tang Ershen [0781 6759 3932], Liu Wumin [0491 0710 3046], and Xu Wenxuan [1776 2429 6513] for their discussion of the plan, and to the operating group, synchrotron radiation laboratory and beam measurement and control group of BEPC for their assistance throughout this work.

References

1. A. Ogata, et al., IEEE NS NS-32(3), (1985) 1943.
2. Yu Hongxuan [0060 7703 3872] and Zhang Qinshen [1728 3830 3932], "Physical Design of BEPC Storage Ring Synchrotron Radiation System," Symposium of Second National "Beam Measurement and Control" Meeting, p 118, 132 (1988).
3. M. Bergher, et al., Nucl. Instru. & Meth., A 237, (1985), 259.

END OF

FICHE

DATE FILMED

5 April 1991